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# Music & Computers

THE MAGAZINE FOR DESKTOP MUSIC

JAN/FEB 1997

## REALTIME INTERNET AUDIO

How It Will Change  
The World

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Rundgren's  
Waking  
Dreams

MAKING  
A CD AT  
HOME

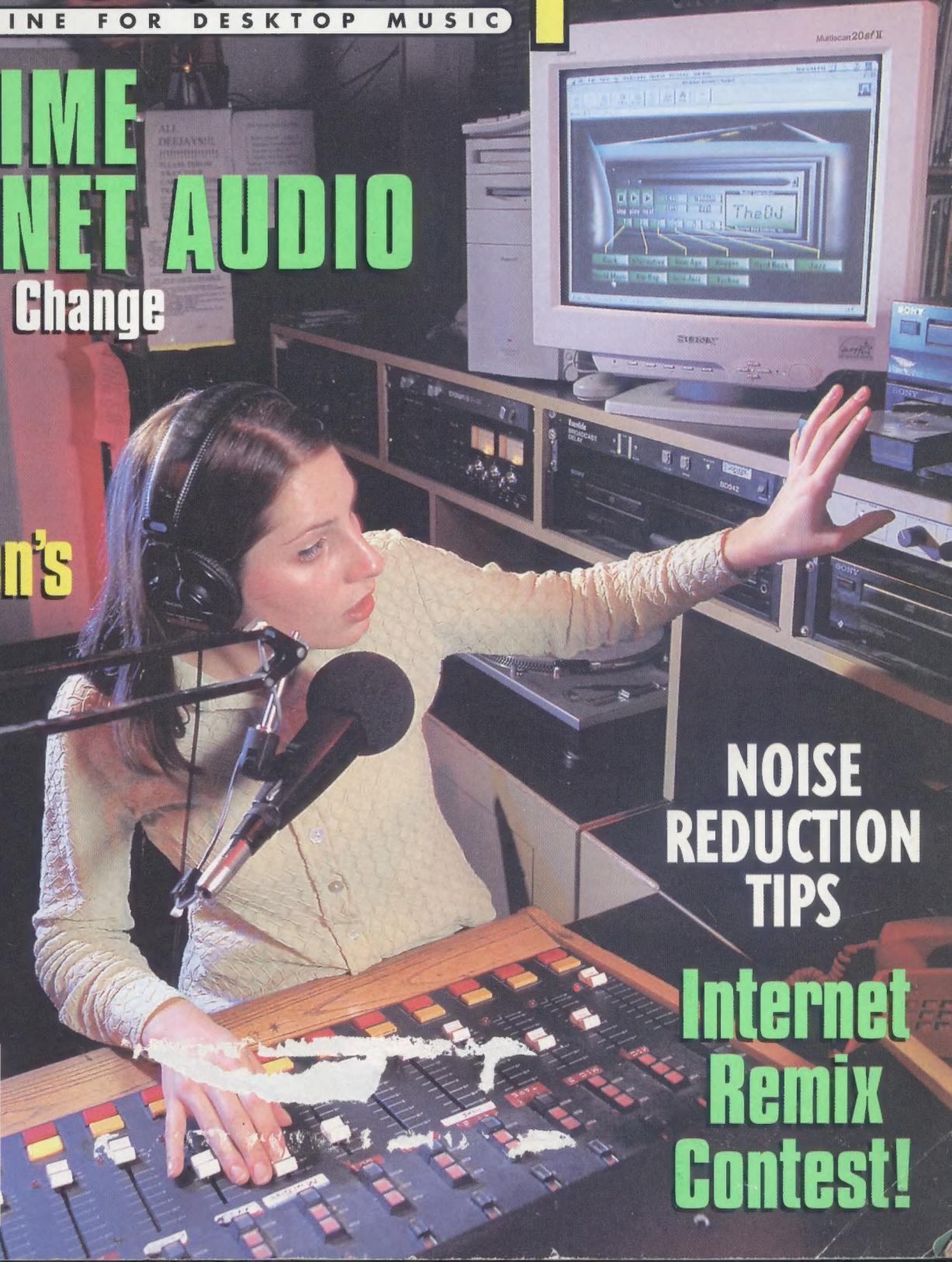
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## MS1202-VLZ • 12x2 • 4 MIC PREAMPS



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<sup>1</sup> except RCA tape jacks, headphone jack & inserts.

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Radio Frequency Interference, caused by computers and TV/AM/FM stations can add audible crud to your mix. Only Mackie Designs mixers have elaborate RFI protection via metal jacks & washers plus internal shunting capacitors.

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Since both are basically chips off our blockbuster 8-Bus Series consoles, they have big-board specs including more dynamic range than compact discs.

Why own an imitation when you can own the brand of compact mixer that serious pros prefer. Call for info today.

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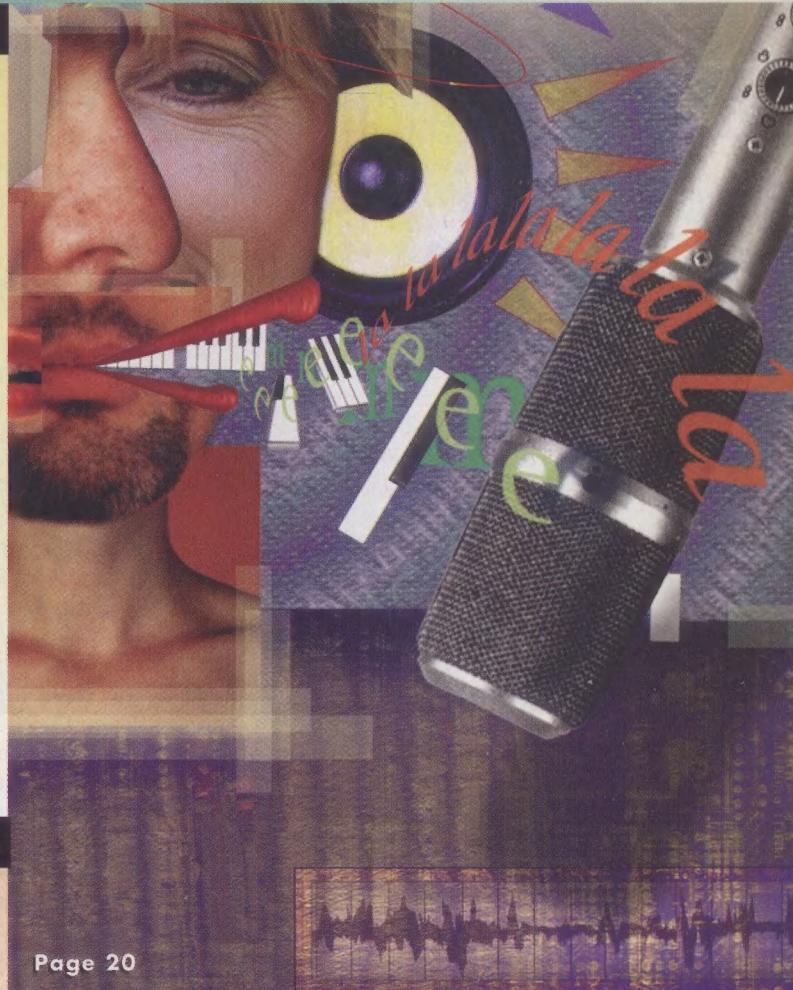


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Our Web-based music review column is rolling in submissions from all over the world. Your tune could be next — all you need is a computer, a MOD, and a modem.

### 77 RIDE THE WIRED SURF by the Fat Man

If you could design the ultimate musical computer, what would it look like?

# From the Editor



**Dancing longhorns** might seem like a strange backdrop to a conference on designing the ideal musical computer. Until you hear that the host of the conference was the Fat Man, the multimedia music star of Texas. I was fortunate to be one of the three journalists at the four-day event, but I really went as a participant. Every letter, fax, and e-mail message sent to *M&C* crosses my desktop, so I had thousands of your computer music questions, triumphs, and opinions on my mind as the stagecoach pulled up at the ranch.

The conference was spectacular. You can get a taste of it in the Fat Man's column (page 77), but so many great ideas were generated that Team Fat is still corralling them. We'll bring you the official results shortly; in the meantime, what do you think the ideal musical computer would look like? Write to us at [m&c@mfi.com](mailto:m&c@mfi.com).

As we were hammering out specs, I kept coming back to my belief that friendliness and ease of use were at least as important as audio doo-dads. Then suddenly it struck me — as much as we're fired up about desktop music here at *M&C*, the desktop isn't really a social place. It's easy to say computers should evolve from bloated calculators into creative partners, but as I kept hearing comments like, "I don't need to hear good sound from my computer when I'm working on a spreadsheet," it became clear to me that the desktop model doesn't go far enough.

I began to see the ideal computer as a powerful art server that lived in the family room. High-bandwidth cables (or wireless transmissions) would connect it to multiple monitors and speakers throughout the house, and a standard socket on each component would let you connect additional devices. Gone would be the separation between computer, TV, and stereo — and, more importantly, the gap between "computer sound" and good sound.

The other crucial component of an Art Computer would be a high-speed Internet connection, and not surprisingly, the Net is already leading the way in combining art, entertainment, and communication. Only days after Todd Rundgren and Brian Balthazor of Waking Dreams showed us their software to connect musicians and music enthusiasts through the Web, Gerry Kearby of Liquid Audio stopped by with another solution. What intrigued me about these encounters, besides the coincidence of their occurring so close together, was that both echoed what I see as a core topic of *M&C* — unveiling a fundamental shift in the way music is created and distributed. A shift away from packaged, pre-digested corporate musical offerings to a world where anyone can create or download the exact kind of music they want to hear, whether from their desktop, their living room, or possibly even their local library. The earthshaking implications of realtime Internet audio seemed like a natural cover story, especially since this issue has our biggest press run ever.

Just as the Fat Man found that getting people out of convention halls and onto a ranch increased the quality and quantity of ideas they came up with, perhaps moving the computer off the desktop and into the family room will help increase the quality and quantity of music in our lives. Until the Art Computer is developed, invite some friends over, make music, and share your sounds and music files with the world. That should keep the longhorns dancing.

—David Battino

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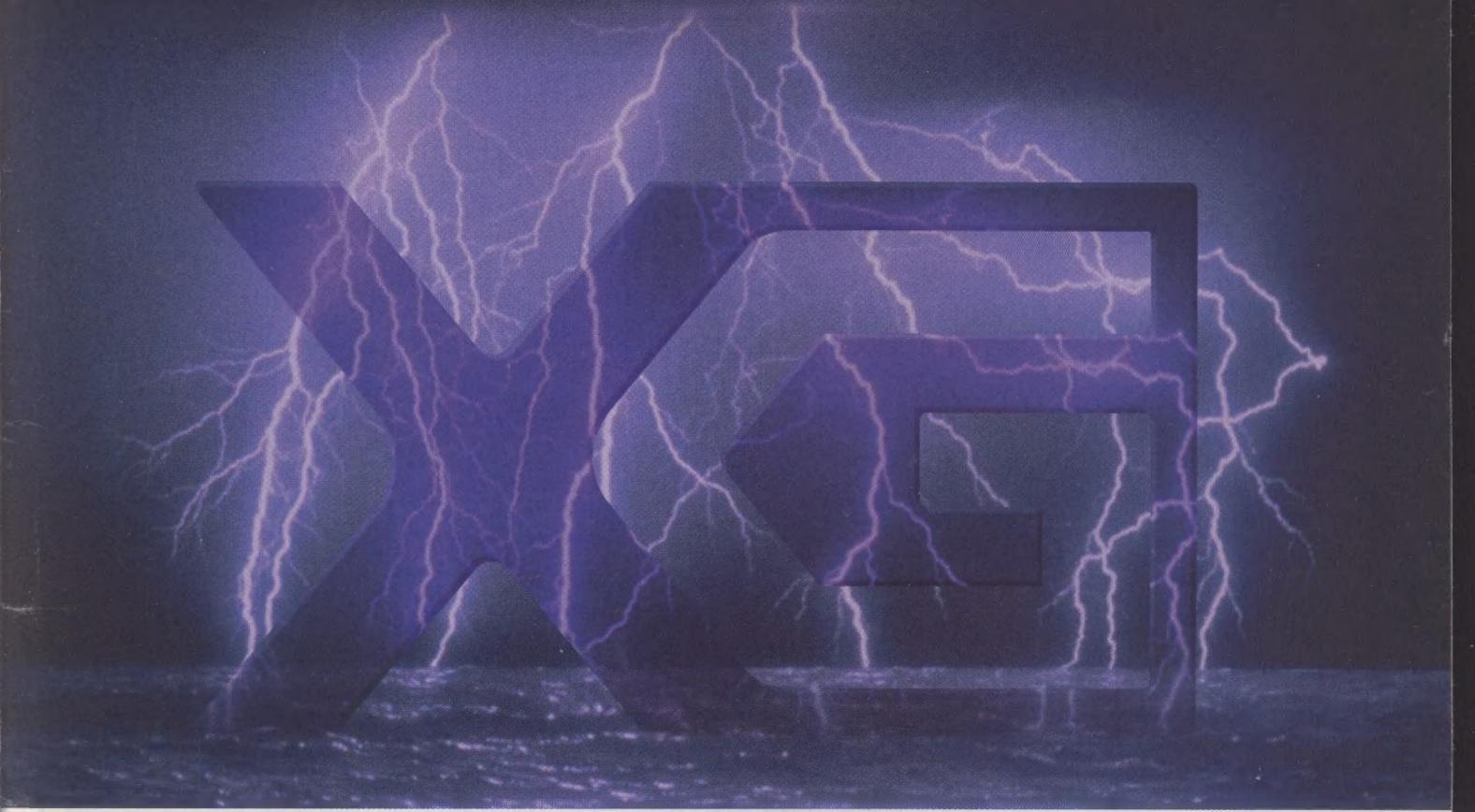
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Yamaha MU50 Tone Generator  
(480 XG voices, 32-note polyphony)

voices. XG significantly beefs up the number and control of these parameters. At its most basic level, XG supports a minimum of three internal effects (reverb, chorus and a switchable global or "insertion" effect). It also adds support for 23 control change messages beyond GM such as sostenuto and soft pedal, filter cutoff and resonance and portamento.

The XG standard is expandable. Higher level XG devices, like the Yamaha MU80 tone generator, include many more features such as a fourth internal insertion effect and an internal stereo graphic EQ so you can create complete productions completely under MIDI control. The MU80 also provides 64 note polyphony and

the ability to input two channels of external audio, like your voice and your guitar, and

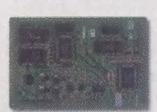


Yamaha MU80 Tone Generator  
(537 XG voices, 64-note polyphony)

mix them and add effects just as if they were synthesizer voices.

And XG, at all levels, expands GM to a minimum of 32 note polyphony. For more information on XG, download "An Introduction to XG" from America Online→ Keyword SSS→Industry News→Yamaha→Product Brochures.

XG is the future of music. And it's here today. Check out the exceptional potential of XG on Yamaha MU50 and MU80 tone generators, the QS300 production synthesizer and the DB50XG sound daughter board. You'll hear why XG makes your music sound so incredible and realistic, we hate to call it a STANDARD.



QS300 Production Synthesizer  
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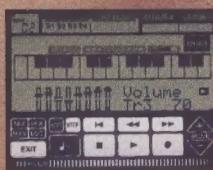
The PMA-5 is the most intuitive creative tool for anyone with a musical thought. Utilizing advanced pen computing technology, the PMA-5 is the ultimate portable

music workstation. It's as simple as touching a pen to a screen. You can perform all operations and even play individual notes from the on-screen keyboard. You can access 600 backing patterns and 100 styles ranging from Monk to Funk and Sting to Swing. And, for on-the-spot improvisations, you can use the ad-lib function to play solos or melodies without knowing anything about music. Choose from over 300 Roland sounds and assign them to any of the 8 tracks in the built-in sequencer. Then add on-board effects including eight types of digital reverb and chorus. The PMA-5 can even function as a 16-part multitimbral GM/GS sound module.

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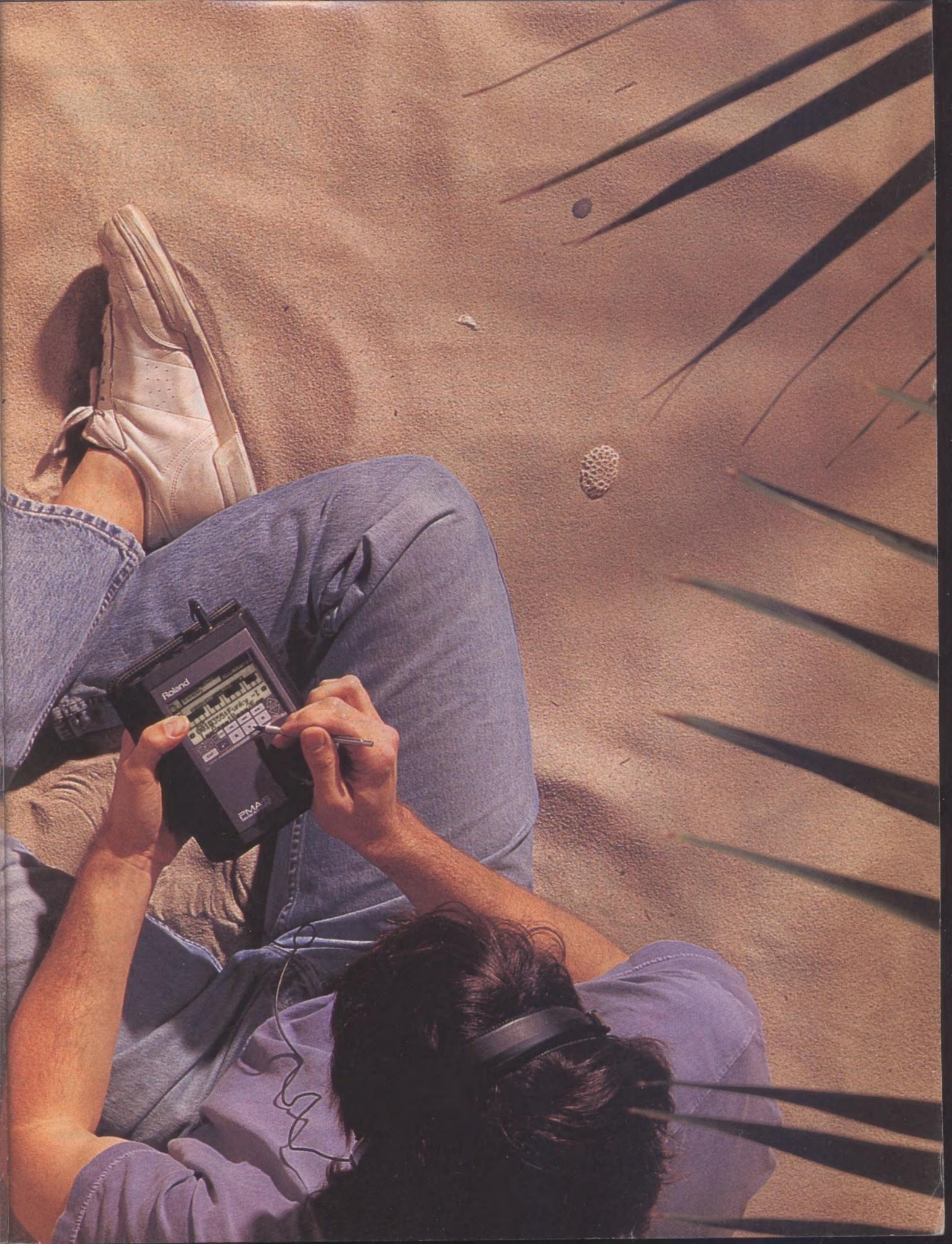


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input

## Men & Noise

I just bought my first copy of your magazine and want to tell you what a great service it is! I am fairly early on the learning curve of computer-assisted music and need the expertise your mag gives. My current problem is this: When I try to record acoustic guitar or vocals in the same small room as my computer, the noise of the CPU gets in the way of making a clean recording. Do you know of any solutions to this? (I don't think I will be able to place the CPU in another room.)

Bill Higgs  
via Internet

Bill — See page 55 for a bevy of tips on noise reduction. Another solution might be to record to tape (actually, the audio tracks on a hi-fi VCR are pretty decent), then transfer that recording to your computer for editing. If you want to record directly into the computer, you could set up your mics and guitar in another room and get a friend to operate the software.

## Feeling Partched

I just found out about your magazine and enjoyed reading your concise and helpful articles, which do not neglect the human side of computer music.

You have a write-up on Artic MIDI Music Utilities for Windows in your Sept/Oct '96 issue. It says the software allows alternate tunings. Do you know of any other software that allows that? Preferably I need to have 43 notes per octave. I'll contact the people at Artic about their software. I hope they had a Web page listed.

Mohammad Reza  
Gharib  
Pasadena, CA  
via Internet

Reza — Programs like Artic's Tuning Wrench and Justonic's Pitch Palette

operate by sending MIDI tuning messages to your synthesizer. This means that they're dependent on the alternate tuning facilities provided by the manufacturer of the synthesizer. While they can't create alternate tunings in an instrument that doesn't allow such tunings, they will make it easier to create and store your own tunings.

You may be thinking of the 43-note-per-octave scale devised by experimental music pioneer Harry Partch. According to Scott Wilkinson's book *Tuning In — Microtonality in Electronic Music* (Hal Leonard), Partch's scale was based on pure mathematical intervals. He needed so many notes not because he necessarily wanted to play a single scale that contained all of them, but because he was building acoustic instruments, and wanted to be able to play in just intonation in many different keys. With a program like Pitch Palette and the right synthesizer, you may be able to get similar results while maintaining a more familiar layout of musical intervals and fingerings on the keyboard.

Alternately, Wilkinson lists the tuning intervals needed to lay out Partch's scale across 43 notes of a keyboard, starting on D1 and ending on A4 — in other words, using three and a half octaves of linear space to cover one octave of pitch. Not all synthesizers allow this level of microtuning, though most samplers should, if you're willing to do some editing.

Look for an article on alternate tunings in an upcoming issue of M&C. While you're waiting, you can contact Artic at 414-534-4309 (74777.2745@compuserve.com), or Justonic at 604-682-3456 (76712.3422@compuserve.com).



## Free for All

I am a subscriber to *Music & Computers*. I look forward to each issue and read it from cover to cover. It is a well-written, nicely laid-out publication.

Yesterday I was in my local magazine store and noticed the latest issue. It was

GET CREATIVE! 21 COOL MIDI TRICKS

bundled with a demo CD of guitar software. Question: Why didn't the loyal subscribers of *Music & Computers* receive this CD? Subscribers should receive these "goodies" too. As a MIDI guitarist, I would have loved to have demo'd this disk. I feel a bit betrayed by the publisher.

Gerald Ross  
Ann Arbor, MI  
via Internet

Gerald — To get your goodies, just see page 15 of that same issue: If you call 800-UBISOFT (824-7638), they'll send you the same CD-ROM that was polybagged onto the cover. Since subscribers could get the same goods by making a free call, we figured it was more cost-effective to attach CDs to just the newsstand issues.

## Sharewhere

I am very interested in Sound Sculptor, the [digital audio recording] shareware mentioned in your Sept/Oct '96 issue [in "Downloading Zone"]. I have a Power Mac 6100 AV and shareware versions of Opcode Audioshop and Macromedia SoundEdit 16. Now I began to be interested in digital recording. But the above software is expensive. So, I would like to register Sound Sculptor with \$30. It's a cool price. Unfortunately, I cannot do Internet. Please let me know the address of MacMedia (distributor of Sound Sculptor).

Kwang Young Park  
Seoul, South Korea

Kwang — We contacted Jeff Smith, the program's creator, who said you can purchase

Write to *Music & Computers*, 411 Borel Ave., Ste. 100, San Mateo, CA 94402; fax: 415-358-9527; e-mail: [m&c@mfi.com](mailto:m&c@mfi.com). Please include your full name. We won't publish e-mail addresses unless instructed otherwise.

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## input

Sound Sculptor by mail; just include an additional \$5. Write to 205 Crystal Springs Center #27, San Mateo, CA 94402. Jeff also has a new program called Realverb PPC 1.1. It's a real-time reverb for Power Macs. Those with Internet access can download it from <http://members.aol.com/realverb/>.



## A Dozen Rowses

**F**irst of all, we absolutely love your magazine! Finally a mag for the rest of us — those of us who don't have \$250,000 budgets for gear, who are trying to make the best out of equipment purchased two months before the manufacturer decided to discontinue it, and who know how to be creative and produce real content with the gear we have. In reference to a question in your Sept/Oct '96 issue from Dwain S. Barefield, who was looking for a 12-tone permutation engine, Duncan Vinson produces a shareware Excel 4.0 template called Atonal Analysis that does this. (Contact Box 74, Sewanee, TN 37375; e-mail: [vinsold0@seraph1.sewanee.edu](mailto:vinsold0@seraph1.sewanee.edu); Web: <http://locust.sewanee.edu>.)

We are working on something similar to accompany a shareware package we created called "LickBuilder." LickBuilder is for composers and improvisers who quickly want to generate the 24 permutations of four-note chords for up to eight chords at once, and save and print them out. It works on Windows and Mac. A demo can be downloaded from <http://www.nettally.com/carma/>. If you would like more information, please contact us.

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Music & Audio) Production  
[carma@nettally.com](mailto:carma@nettally.com)  
via Internet

**R**egarding Mr. Dwain S. Barefield's inquiry into software for 12-tone techniques, the following is an ftp site for such software: <ftp://ftp.prz.tu-berlin.de/pub/MusicAnalysis/>. Also, Alexander R. Brinkman's book *Pascal Programming for Music Research* (University of Chicago Press, 1990) carries a lot of useful code for set-theoretical analysis of 12-tone music.

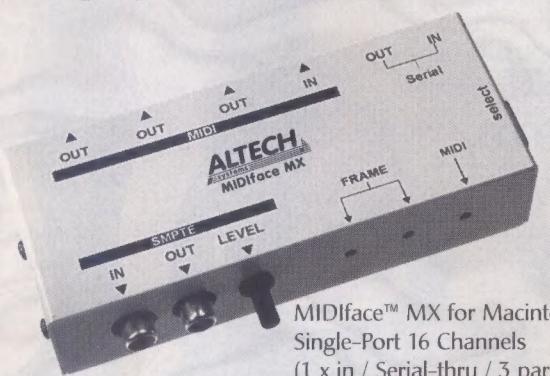
Akira Takaoka  
Keio University  
Tokyo, Japan  
via Internet

**O**pcode Max [MIDI processing software] currently ships with an excellent application written by Karlheinz Essl called "RTC-lib 2.1." It is an extensive Max patch that serves as a set of compositional tools, among other things. One of the tools is a patch designed specifically for manipulating rows. It could do what Dwain is looking for, and a whole lot more.

Butch Rovan  
Max/Hardware/OMS Product Manager  
Opcode Systems  
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# Self-powered

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Spirit's newest micro mixer packs versatile professional features into the smallest package yet!

Unlike many small mixers, Notepad is no toy. It incorporates tried and trusted circuit designs and components used on our flagship mixing desks.

Folio Notepad is a compact DAT-quality 10 input stereo mixer that is flexible enough to be used in a wide variety of applications, either as the main mixer in small configurations or as a submixer in larger setups.

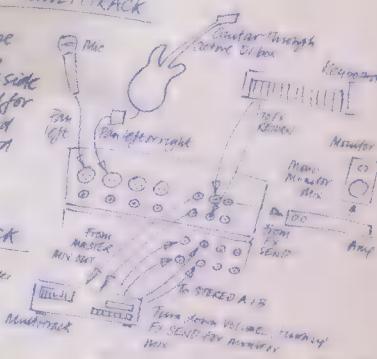
## MULTIMEDIA

Recording and playback of music using a PC fitted with stereo sound card

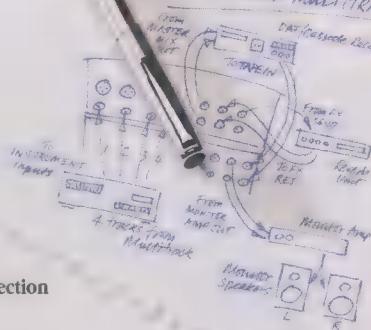


## RECORDING TO MULTITRACK

Record up to 2 tape tracks at once. Pan instruments to same side if they are destined for the track or Pan hard left and right to record in two separate tracks



## MIXDOWN FROM MULTITRACK



## PROFESSIONAL FEATURES

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- separate Mix and Monitor outputs
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- Noise -85 dBu typical
- Freq Response 20Hz - 20kHz
- THD <.0005% typical

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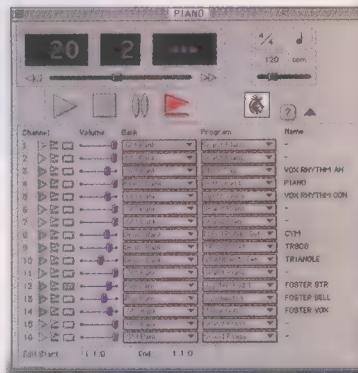
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Forget those arcade sounds—CyberSound packs enough high-powered instrumentation to make Megadeath sound like Mister Rogers. Including ready-to-use CyberGrooves and Solo Songs, plus 17 different drumsets and 223 instruments created exclusively for CyberSound by platinum-selling audio pros.

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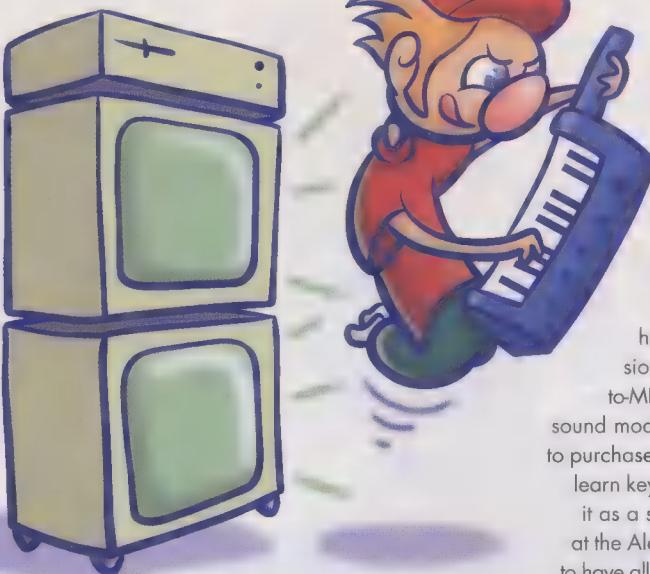
We also got a call from Cakewalk Music Systems, who confirmed that a CAL (Cakewalk Application Language) macro for creating 12-tone rows is available for their Windows sequencer, Cakewalk.

### Knife the Mac

**I** have purchased every issue of M&C since it came out. With every issue, you lean more towards the Mac than the IBM clone. The Sept/Oct '96 issue's three feature articles are all for the Mac (or talk about the Mac), and since one of them is a three-part article, it looks like I'll save \$10 by not buying the next two issues. Maybe you should have four feature articles, two for the Mac and two for the IBM, or change the name to MM&C, for Mac Music & Computers.

"VagueNation"  
via Internet

VagueNation — Interestingly, until now the complaints about editorial balance have been



from Mac users concerned that we had too much PC emphasis. Those three stories do indeed mention the Mac, but only the Max article is specifically about a Mac program. Then there are three reviews of Windows programs, a collection of MIDI tips, and four platform-independent columns. Even when we mention specific platforms, we strive to provide

techniques that are valid for a number of platforms and programs.

### MIDI Guitar

**I** am a subscriber to M&C and love the magazine. The information I get is great, and it helps me in product buying decisions. I use a Shadow SH075 guitar-to-MIDI converter with my Korg 05R/W sound module. Works great, but now I want to purchase a keyboard synthesizer. I want to learn keyboards, but would like to also use it as a second sound module. I'm looking at the Alesis QS7. Sounds great and seems to have all I need, but will I have trouble "tracking" with my SH075? I found in my search that certain synthesizers don't track as well as others with the SH075; e.g., I had problems with the Roland Sound Canvas. That's why I bought the Korg; it's fine. Alesis says, "No problem, any MIDI controller will be fine." But I'm not sure they're unbiased.

Brad Hofrichter  
via AOL ►

## OWN A 128-TRACK DIGITAL STUDIO...

**D**igital Wings for Audio delivers you from 8-track tyranny with a stunning 128 real tracks (not "virtual" tracks) of hard disk recording — with no data compression. Running on Pentium PCs (16 MB RAM/Win95), the system includes both hardware and software; forget the installation nightmares of coaxing one company's software to work with another company's sound card.

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JANUARY/FEBRUARY 1997 • MUSIC & COMPUTERS

11

Brad — Consulting editor Jim Aikin recently did MIDI timing tests on a variety of synthesizers for our sister magazine *Keyboard* (July '96, p. 77). The Alesis QS6 (the QS7 with fewer keys) was one of the top performers. However, response time is not the only factor that can lead to glitching. We also checked with MIDI guitar guru Craig Anderton. He said the tracking difficulties you encountered could be due to the way you set up the sound module, and promised to start working on a "how to evaluate sound modules for use with MIDI guitar" article. Stay tuned. . . .

## MOD Slingers

In the Sept/Oct '96 issue, there was a letter from Adam B. Whiteman, who wanted to create a song that would be transferable/composable over the Internet. Well, I've got your solution, Adam — and it's not MIDI or MPEG or any of those ridiculously obsolete formats. It's MOD files. You compose with samples (creatable without an external sampler) by arranging them in patterns that scroll vertically. This method of creating music is incredibly underground, and is the possible

ingredient for a new music revolution, because an average .MOD/.IT/.XM file only takes up about one-third of a meg! You don't need keyboards, you don't need samplers, you don't need any external equipment. And best of all, all the programs that work in this format are absolutely free. [Ed. Note: Well, many of them are.]

The best [PC] tracking programs are Impulse Tracker and FastTracker. You can find them at <ftp://cdrom.com> in the directory [/pub/demos/music/programs/trackers](pub/demos/music/programs/trackers). If you have a Web browser (and I'm assuming a soundcard), check out the following sites: <http://www.kosmic.com>, <http://www.accomp.com/~keith/ls>, and <http://www.carcass.org>. This is the future of music on the Net. MPEG will die, trust me.

Morgan W. Page  
President, Landslide  
<http://www.accomp.com/~keith/ls>  
via Internet



## Dreams do come true!

You've always known the features you've needed in a MIDI keyboard controller, but the high price-tags of feature-rich controllers have made owning one seem like an impossible dream. That is until now...Fatar introduces five controllers with the features you need at prices you can afford, starting as low as \$209.95. The ST610/Plus with aftertouch, ST-610, ST-490/Plus, ST-49, and CMS-61 all have features you've dreamed of as well as some you probably haven't.



For instance, the CMS-61 (pictured) has an ergonomic design which allows it to fit comfortably in with your computer's set-up.\* And all of these remarkable Fatar controllers are extremely user-friendly. You'll get more, but won't pay more for a Fatar. So stop in at your local dealer and try a new Fatar MIDI controller. Or send \$2.00 for a full color catalog, or \$5.00 for a CD-ROM interactive product demo, and see how Fatar can make your fantasy become a reality.

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\*QWERTY keyboard and mouse not included.  
CD-ROM demo is compatible for MAC and IBM

## Get Back

Just want you to know I love your magazine. A friend wired me up to you guys and the information you give is right on time. I wanted to know how I could get the July/August '96 issue featuring IUMA. Their business interests me a lot, and I want to learn more about how to get music on my computer and then to my Web site. Since I am a beginner, any additional information on those subject matters would be very much appreciated.

Raphael Hargrave  
via Internet

Raphael — To order back issues, e-mail [orders@mfi.com](mailto:orders@mfi.com) or call 800-444-4881 or 913-841-1631.

## Correction

In my article "Digital Audio Plug-Ins" in the Nov/Dec '96 issue, I made two errors. I said that if a Digidesign audio card or PowerPC chip is not found in the host computer, then Digidesign's AudioSuite will "look for a 68k processor with an FPU to get the job done." In fact, AudioSuite does not require an FPU to run on a 68k machine. Secondly, the acronym DAE actually stands for "Digidesign Audio Engine." My apologies to those hard-working folks at Digi.

Mikail Graham  
via Internet

That's okay, Mikail. We misspelled your band's name. It's actually "Rites of Passage." 



**"Sorry, Jim, no poker game tonight—Janey, the kids and I are learning to play the piano with our home computer!"**



### **Presenting the fun, easy way to play— Learn Piano!**

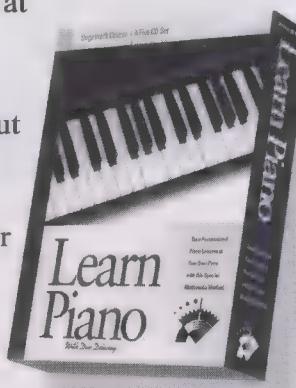
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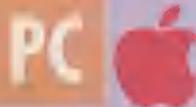
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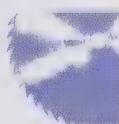


# Cutting Edge

by Debbie Greenberg & Mark Vail



According to our surveys, many of you own both Macs and PCs. **Mark of the Unicorn (MOTU)** aims to widen your musical options with the **MIDI Express XT** (\$395), a MIDI interface that lets you connect either a Mac or a PC (or both at once) to multiple MIDI devices. The **MIDI Express XT** offers eight MIDI Ins, nine MIDI Outs, 128 MIDI channels (16 channels times eight cables), and front-panel-recallable presets. It reads and generates SMPTE timecode, allowing you to synchronize SMPTE-savvy sequencers to audio tape. Its click-to-MIDI feature can convert an audio signal, such as a click track or kick drum, into MIDI timing information. **Contact:** Mark of the Unicorn, 1280 Massachusetts Ave., Cambridge, MA 02138; 617-576-2760; fax: 617-576-3609; e-mail: [info@motu.com](mailto:info@motu.com); Web: <http://www.motu.com>. **Circle #168** on reader service card.



It's tough to play an expressive melody with a conventional wavetable synth or soundcard, because they create sound by playing back short preset recordings. You can vary a few things, like volume and sometimes brightness, but the basic character of the sound doesn't change. **Yamaha's VL70-m** MIDI sound module (\$799.95), on the other hand, uses the same *physical modeling* technology as their \$5,000 VL1 Virtual Acoustic Synthesizer. Rather than relying on preset waveforms, Virtual Acoustic Synthesis uses a computer model to simulate the physical characteristics of an acoustic instrument, so each note can sound quite different. The VL70-m permits

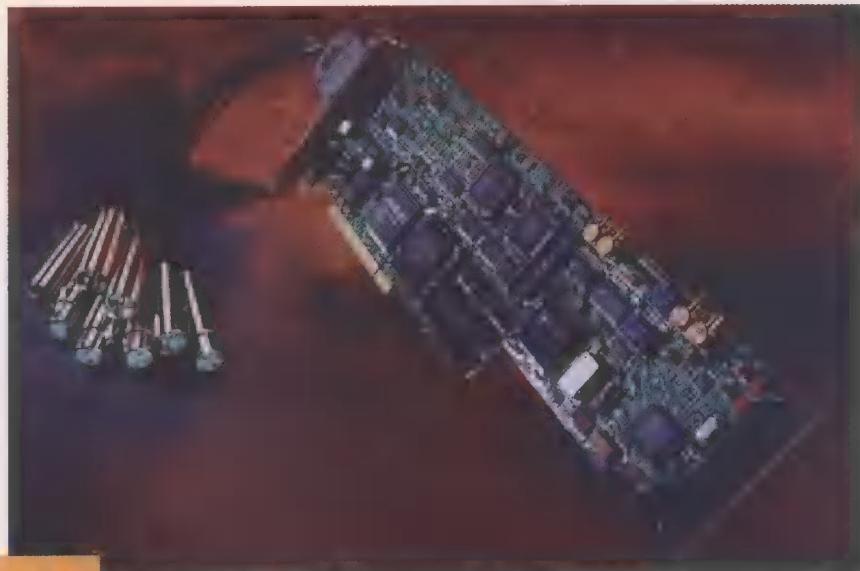
control over characteristics such as breath and reed pressure to affect the timbre of the sound. By blowing into an optional breath controller and triggering the VL70-m's pitch from a MIDI keyboard, you can create expressive solo and melodic voices. (The instrument plays just one note at a time.) The VL70-m can also be used in conjunction with Yamaha's WX11 clarinet-shaped MIDI wind controller.

With Yamaha's free **VL Expert Editor** software (downloadable from Yamaha's Web site), you can create and perform deep-level edits on the physical modeling structure of a sound in any of the VL-series products. **Contact:** Yamaha, Box 6600, Buena Park, CA 90622-6600; 714-522-9011; fax: 714-739-2680; e-mail: [Info@Yamaha.com](mailto:Info@Yamaha.com); Web: <http://www.yamaha.com>. **Circle #169** on reader service card.



Multimedia goes mobile: **Sceptre Technologies' Soundx 4000** notebook computer (\$5,459) offers

Sound Blaster Pro compatibility, a 12.1" SVGA display, 133MHz Pentium processor, and removable 6X CD-ROM and 1.3Gb hard drives. (The CD-ROM drive bay also accepts a floppy drive or additional battery.) The Soundx 4000 generates little heat and draws minimal power due to its 2.9-volt CPU design, resulting in a significant increase in battery life. Other features include the Neo Magic video chipset with built-in video RAM for faster video processing, a Windows 95 hot key, and an infrared link that can be rotated 180° for wireless data transmission. A motorized docking station with additional stereo speakers is available. **Contact:** Sceptre Technologies, Inc., 16800 E. Gale Ave., City of Industry, CA 91745; 818-369-3698; fax: 818-369-3488. **Circle #170** on reader service card.

**PC**

Feeling limited by your sound-card's mediocre stereo I/O?

**Antex Electronics' StudioCard** (\$1,595) offers four channels of 18-bit sound and real-time digital mixing. StudioCard delivers less than 0.003% total harmonic distortion and 92dB dynamic range, and features a programmable 32-bit 40MHz digital signal processor, four independent balanced I/Os (at either +4dBu or -10dBV levels), AES/EBU or S/PDIF digital audio I/O, and an MPU-401-compatible MIDI port. The StudioCard offers sample-accurate synchronization

via SMPTE, MTC (MIDI Time Code), host clock, and external word clock, and reads and generates SMPTE time code. An onboard SPx expansion connector enables the use of optional daughtercards for enhanced DSP operations. StudioCard is plug-and-play compatible and includes Windows NT drivers. Multiple StudioCards can be installed in a single computer for up to 16-track recording. **Contact:** Antex Electronics, 16100 S. Figueroa St., Gardena, CA 90248; 310-532-3092; fax: 310-532-8509. **Circle #171 on reader service card.**

**PC**

**AVM Technology**  
and **Kurzweil**

have combined forces to deliver **Apex** (\$299), a plug-and-play ISA soundcard. It offers 32-note polyphony, 20-bit digital-to-analog converters, 2Mb of Kurzweil wavetable ROM, sample RAM expansion up to 64Mb using off-the-shelf 72-pin SIMM modules, Sound Blaster Pro compatibility, 3D surround sound, and 24-bit effects, including reverb, chorus, delay, flange, and distortion. 16-bit stereo digital audio can be recorded at sample rates ranging from 5Hz to 55.2kHz. The card provides up to four independent channels of digital audio for hard disk recording, with simultaneous record and playback. You can also import digital audio directly from a CD-ROM drive. Apex comes with full software support for DOS, Windows 3.1, and Windows NT, and includes Cakewalk SE MIDI sequencing/hard-disk recording software and a patch editor. **Contact:** AVM Technology, 9774 S. 700 E., Sandy, UT 84070; 801-571-0967; fax: 801-571-3634; Web: <http://www.avmtechnology.com>. **Circle #172 on reader service card.**

**PC**

Itching to compose a tune on your computer? **Passport's MusicTime**

**Deluxe** (\$99) allows you to print music with lyrics, text, and guitar chords on up to 16 staves. Music can be entered via mouse, computer keyboard, or MIDI instrument. The program will display the notation and allows you to add guitar chord diagrams and chord names to scores and lead sheets. The software also features automatic import/export of any Standard MIDI, Master Tracks Pro, or MIDI Workshop file. MusicTime Deluxe lets you place notes and rests anywhere in a score, enter text (in any font, size, and style) anywhere on a page, input song lyrics that line up with notes, and change the key, clef, and time signature anywhere in your score. You can print Standard MIDI Files as finished sheet music, and print an entire score or individual pages. **Contact:** Passport Designs, 1151 Triton Dr., Ste. D, Foster City, CA 94404; 415-349-6224; fax: 415-349-8008. **Circle #173 on reader service card.**

**PC**

Be a remix DJ from the comfort of your desktop: The **Mixman** CD-ROM (\$34.95) contains eight tracks with styles ranging from hip-hop and house to ambient and acid jazz. Featured artists include Coolio, K7, Planet Soul, Mephisto Odyssey, Seraphim, Civilization, Electroliners, and Groove Connection. The artists' original digital multitrack recordings have been transformed into the Mixman music format and separated into 16 elements (drums, percussion, bass, synth, etc.). The software automatically synchronizes each element to make real-time mixing easy. User controls include Lock, FX, Break, Record, and Tempo. **Contact:** Mixman Technologies, 850 Montgomery St., Ste. 350, San Francisco, CA 94133; 888-4MIXMAN or 415-403-1380 (orders), 415-403-1385 (tech support); e-mail: [info@mixman.com](mailto:info@mixman.com); Web: <http://www.mixman.com>. **Circle #174 on reader service card.**

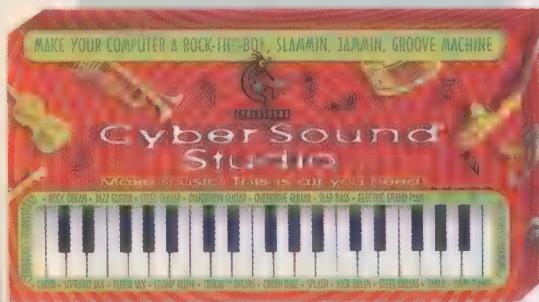


# Cutting Edge



InVision Interactive is now

bundling a compact MIDI keyboard and a computer-to-MIDI interface with CyberSound VS, their software-based synthesizer (see Cutting Edge, May/June '96), and selling the whole shebang for less than half of what the software alone used to cost. The **CyberSound Studio** bundle (\$99) is designed to be a one-box on-ramp to desktop music: Plug the keyboard into your Power Mac, and the computer itself becomes a synthesizer. (You can also use a QWERTY keyboard.) The new version 2.0 software features hundreds of improved sounds, including sampled drum grooves for one-finger jamming. (A CD-ROM with almost 300 additional sounds is available for \$39.95.) CyberPlayer, the integrated MIDI sequencer, now offers volume sliders for each track and pitch-to-MIDI conversion, so you can sing your part in as well as play it. **Contact:** InVision Interactive, 2445 Faber Pl., Ste. 102, Palo Alto, CA 94303; 800-468-5530 or 415-812-7380; fax: 415-812-7386; e-mail: [joshc@cybersound.com](mailto:joshc@cybersound.com); Web: <http://www.cybersound.com>. **Circle #175 on reader service card.**



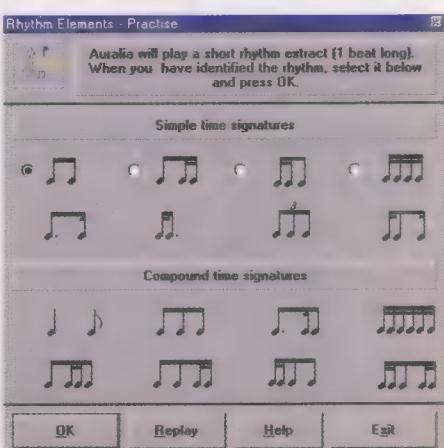
PC

You don't have to know how to play an instrument — in fact, you don't have to know much about music at all — to play **Hotz Trax** (\$49.95). All you need is a standard computer keyboard and some creative juices, and you'll be ready to jam along with your favorite artist or song. Choose from a plethora of Hotz-coded songs or play your own little ditties — you can use any of the 128 musical instruments and edit, record, overdub, mix, and save the creations. Share your music with others — even online — who can add their own

tracks. **Hotz Trax** is compatible with Standard MIDI Files and many off-the-shelf CDs. **Hotz Player**, an introductory version, can be downloaded from the Hotz Web site at no cost. **Hotz Trax** and **Hotz Player** require a 486DX/66MHz or faster PC running Windows 3.1 or 95 with at least 8Mb RAM. CD-ROM and Mac versions are due early this year. **Contact:** The Hotz Corp., 837 19th St., Santa Monica, CA 90403; 310-828-1582; fax: 310-828-3802; e-mail: [hotzmail@hotz.com](mailto:hotzmail@hotz.com); Web: <http://www.hotz.com>. **Circle #176 on reader service card.**

PC

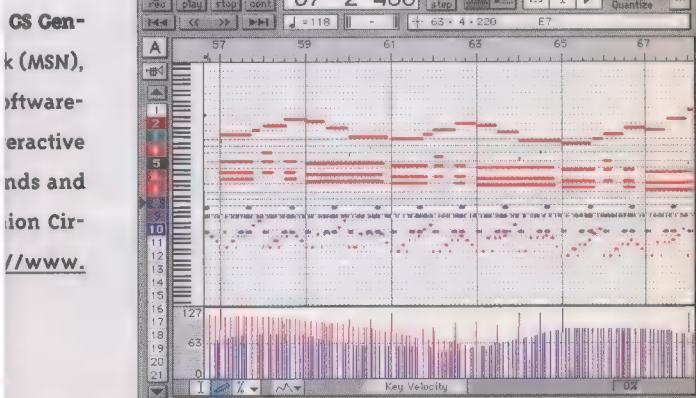
**Auralia** for Windows (\$149 single copies; \$795 site license) is an ear-training course designed for music students of all ages and skill levels. Make your way through 12 major subject areas (cadences, chords, cluster chords, chord progressions, interval recognition, interval singing, jazz chords, meter, pitch, rhythm dictation, rhythm elements, and scales) at your own pace. Each section has several levels of increasing difficulty. Set goals and track your progress by recording practice statistics, which can be viewed or printed. Teachers can use **Auralia**'s testing features to prepare quizzes; tests can be named and saved and statistics can be recorded. **Contact:** Rising Software, 31 Elmhurst Rd., Blackburn, Victoria, Australia 3130; 61-3-9894-4788; fax: 61-3-9894-3362; e-mail: [rising@rising.com.au](mailto:rising@rising.com.au); Web: <http://www.rising.com.au>. **Circle #177 on reader service card.**



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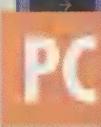
Opcode Systems has improved Musicshop, their entry-level MIDI sequencer. The program is now available for both Macintosh and Windows computers. **Musicshop Version 2.0** (\$149.95 Mac, \$99.95 Windows, \$59.95 upgrade for registered Musicshop and EZ Vision owners) offers 32 tracks of recording, a 32-track automated mixer, full OMS (Open Music System) and QuickTime Musical Instrument support, and virtually unlimited nested sequences. Other Musicshop enhancements include real-time editing, WYSIWYG print preview, refined quantization controls, Opcode Galaxy patch librarian compatibility, and online help via the Internet (Windows only).

For a limited time, upgrades and new purchases will include 100 royalty-free General MIDI songs in styles including country, rock, jazz, and classical. The software is also available in academic lab packs (licensing for five machines) to qualified educators. **Contact:** Opcode Systems, 3950 Fabian Way, Ste. 100, Palo Alto, CA 94303; 415-856-3333; fax: 415-856-0777; Web: <http://www.opcode.com>. **Circle #181 on reader service card.**

# Cutting Edge



InVision Interactive is now bundling a compact MIDI keyboard and a computer-to-MIDI interface with CyberSound VS, their software-based synthesizer (see *Cutting Edge*, May/June '96), and selling the whole shebang for less than half of what the software alone used to cost. The **CyberSound Studio** bundle (\$99) is designed to be a one-box on-ramp to desktop music: Plug the keyboard into your Power Mac, and the computer itself becomes a synthesizer. (You can also use a QWERTY keyboard.) The new version 2.0 software features hundreds of improved sounds, including sampled drum grooves for one-finger jamming. (A CD-ROM with almost 300 additional sounds is available for \$39.95.) CyberPlayer, the integrated MIDI sequencer, now offers volume sliders for each track and pitch-to-MIDI conversion, so you can sing your part in as well as play it. **Contact:** InVision Interactive, 2445 Faber Pl., Ste. 102, Palo Alto, CA 94303; 800-468-5530 or 415-812-7380; fax: 415-812-7386; e-mail: [joshc@cybersound.com](mailto:joshc@cybersound.com); Web: <http://www.cybersound.com>. **Circle #175 on reader service card.**



you don't at all — the need is a some crea jam along Choose fr or play yo any of th edit, recor ations. S even on



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# Free Info!

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A MIDI merger: Roland has licensed its Sound Canvas sound set and CS General MIDI extension to Microsoft for inclusion in the Microsoft Network (MSN),

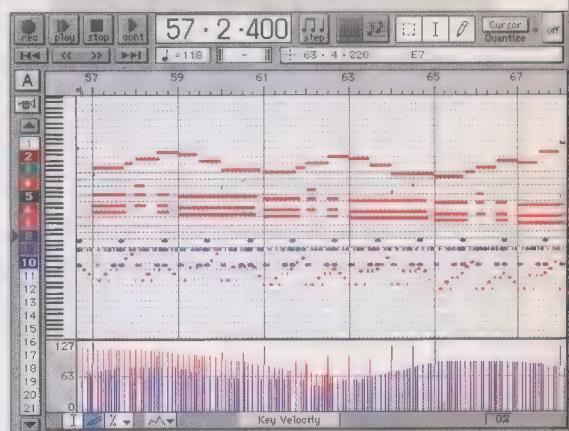
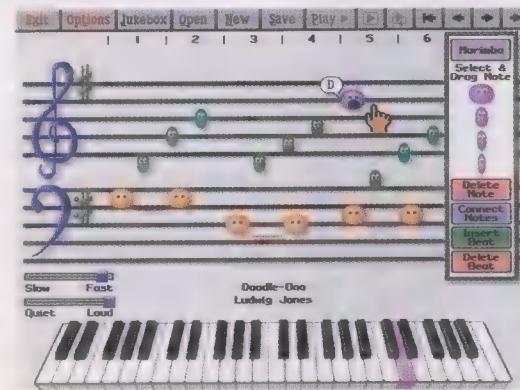
DirectMusic architecture, ActiveX, and future desktop products, including a software-based synthesizer. This will offer standardized MIDI-based audio output to interactive software developers and users. Microsoft plans to demonstrate the new sounds and synth on *Riff*, MSN's interactive music show. Contact: Roland, 7200 Dominion Circle, Los Angeles, CA 90040; 213-685-5141; fax: 213-722-9233; Web: <http://www.rolandus.com>. Circle #178 on reader service card.



## UPDATES

The composition component in **Harmonic Vision's** Music Ace music education software (see *Cutting Edge*, July/Aug '96) is now available as a separate program. The

**Music Doodle Pad** (Windows 95 and 3.1 versions, \$29.95; Mac version under development) offers an assortment of cheerful and easy-to-use musical tools for arranging, modifying, saving, and listening to your original creations. Six instruments and four note values (full, half, third, or quarter beats) are found on the Sound Palette. Simply drag the "Singing Notes" (colorful animated notes that "sing" each musical creation) into place on the staff. You can mix and match notes with instrument sounds, connect notes, and insert or delete beats. Dozens of popular compositions by composers such as Bach and Beethoven are included as source material to be modified to satisfy your creative urges. All compositions can be saved to disk. **Contact:** Harmonic Vision, 906 University Pl., Evanston, IL 60201; 847-467-2395; fax: 847-467-3008. **Circle #179 on reader service card.**



Opcode Systems has

improved Musicshop, their entry-level MIDI sequencer.

The program is now available for both Macintosh and Windows computers.

**Musicshop Version 2.0** (\$149.95 Mac,

\$99.95 Windows, \$59.95 upgrade for registered Musicshop and EZ Vision owners) offers 32 tracks of recording, a 32-track automated mixer, full OMS (Open Music System) and QuickTime Musical Instrument support, and virtually unlimited nested sequences.

Other Musicshop enhancements include real-time editing, WYSIWYG print preview, refined quantization controls, Opcode Galaxy patch librarian compatibility, and online help via the Internet (Windows only).

For a limited time, upgrades and new purchases will include 100 royalty-free General MIDI songs in styles including country, rock, jazz, and classical. The software is also available in academic lab packs (licensing for five machines) to qualified educators.

**Contact:** Opcode Systems, 3950 Fabian Way, Ste. 100, Palo Alto, CA 94303; 415-856-3333; fax: 415-856-0777; Web: <http://www.opcode.com>. **Circle #181 on reader service card.**



**Mackie Designs' UltraMix Pro**, a universal fader/mute automation system for audio mixers, has sprouted some new features.

In addition to speed improvements and bug fixes, **Version 1.11** (\$2,797; upgrades are free) makes files interchangeable between Mac and PC platforms. Enhancements include a new edit filter, improved event editor and default mix snapshot, program change editing, destructive soloing, and a new Quick Start manual. Key encryption for the Macintosh program has been removed. UltraMix Pro is 32-bit and directly supports OMS 2.1, FMS 1.24, and Windows 95. The upgrade is available via BBS (206-488-4586) or on Mackie's Web site. **Contact:** Mackie Designs,



16220 Wood-Ridge Rd. N.E.,  
Woodinville, WA 98072; 800-898-3211 or 206-487-4333;  
fax: 206-487-4337; e-mail: [sales@mackie.com](mailto:sales@mackie.com); Web: <http://www.ultramix.com>.

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# BAND-IN-A-BOX™

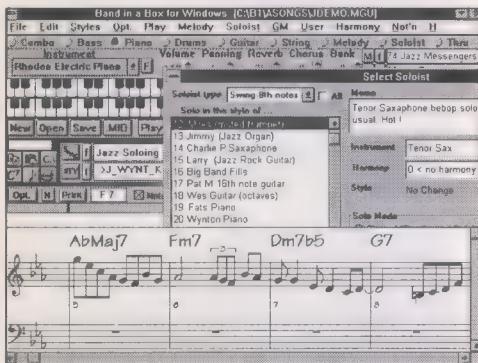
## VERSION 7.0 FOR WINDOWS

**INTELLIGENT SOFTWARE FOR IBM (WINDOWS/DOS) \***

(\* NOTE: MACINTOSH available in Ver. 6. ATARI Band-in-a-Box available only in Ver. 5)

**Version 7 for Windows is here. Automatic Accompaniment has arrived!**

Type in the chords to any song, using standard chord symbols like C or Fm7b5, choose the style you'd like and Band-in-a-Box does the rest... Automatically generating professional quality five instrument accompaniment of bass, drums, piano, guitar & strings in a wide variety of styles.



**100 STYLES INCLUDED WITH PRO VERSION.** Jazz Swing • Bossa • Country • Ethnic • Blues Shuffle Blues Straight • Waltz • Pop Ballad • Reggae • Shuffle Rock • Light Rock • Medium Rock Heavy Rock • Miami Sound • Milly Pop • Funk • Jazz Waltz • Rhumba • Cha Cha • Bouncy 12/8 Irish • Pop Ballad 12/8 • Country (triplet) • and 75 more!

**BUILT-IN SEQUENCER ALLOWS YOU TO RECORD OR EDIT MELODIES.****BUILT-IN STYLEMAKER™.** You can create your own 5 instrument styles using the StyleMaker section of the program.**SUPPORT FOR OVER 70 SYNTHS BUILT-IN.** Drum & patch maps included for over 70 popular synths. General MIDI, Roland GS & SoundBlaster soundcard support included.**STANDARD MUSIC NOTATION** and leadsheet printout of chords, melody and lyrics. Enter your songs in standard notation & print out a standard lead sheet of chords, melody and lyrics.**AUTOMATIC HARMONIZATION.** You can select from over 100 harmonies to harmonize the melody track, or harmonize what you play along in real time. Play along in "SuperSax" harmony, or harmonize the melody with "Shearing Quintet". Create your own harmonies or edit our harmonies.**NEW! Additional features in Windows Version 7.0****Band-in-a-Box 7.0 for Windows breaks new ground with over 60 new features!**

Band-in-a-Box 7.0 is here! This major upgrade includes over 60 new features. We've added an amazing new feature called "Automatic Soloing". Choose the type of soloist you'd like (from 100 available) and the program creates and plays a solo in that style, along to any song! Or create your own soloists. This is hot! These solos are of the highest professional quality, rivaling solos played by great musicians! And there's lots more in 7.0 - improved notation, step time/notation edit of StyleMaker patterns, style changes at any bar, scroll ahead option for notation, improved synth support, over 60 new features in all!

**OUR CUSTOMERS LOVE VERSION 7.0 FOR WINDOWS!****"Wow! The soloing sounds amazing... how can it do that?"****"I love the notation improvements."****"Another winner - thanks!"****"You guys have added everything I wanted."**

**"Band-in-a-Box is an amazing program"**

Keyboard Magazine

*"I am in awe. I didn't think that such an incredible program could even exist. This software is a dream come true."*

PC Journal

**- FINALIST -**  
PC Magazine Award  
for Technical Excellence

After Hours Entertainment  
Band-in-a-Box - PG Music**BAND-IN-A-BOX PRICES****NEW CUSTOMERS (IBM/Macintosh/Atari\*)**

Band-In-A-Box Pro (first time purchase) ..... \$88  
Version 7, Styles Disks 1-3, Harmonies Disk 1 + Soloists Disk 1

SUPERPAK (first time purchase) ..... \$147  
The SuperPAK includes Pro version 7, Styles Disks 1-5, Harmonies Disk 1 + Soloists Disk 1

ULTRAPAK (first time purchase) ..... \$189  
The UltraPAK includes Pro version 7, Styles Disks 1-8, Harmonies Disk 1 + Soloists Disk 1

(\* MACINTOSH Band-in-a-Box available in Version 6; ATARI available only in Version 5)

**ADD-ONS**

Styles Disk #4	.....	\$29
Styles Disk #5	.....	\$29
Styles Disk #6	.....	\$29
Styles Disk #7	.....	\$29
Styles Disk #8 (included with Version 7 upgrade)	.....	\$29
MIDI-FakeBook (100 songs on disk)	.....	\$29

**UPGRADES**

Regular Upgrade to Version 7 (for Windows) ..... \$49  
Includes Styles Disk 8 + Soloists Disk 1. Upgrade from Version 6 for Windows

Complete Upgrade to SUPERPAK ..... \$69  
Includes Regular Upgrade to Version 7 + Styles 1-5. Order this if you have an older version of Band-in-a-Box (pre-version 5) or if you are "cross grading" to a different type of computer, or if you do not have Styles Disk 4.

Complete Upgrade to ULTRAPAK ..... \$89  
Includes SuperPAK (above) + Styles 1-8 (these are all the Styles Disks we have made for Band-in-a-Box!).

**MEMORY REQUIREMENTS:** DOS (640K), Windows (4 mb), Macintosh (4 mb), Atari (1040)**HELP!** I forgot to send in the Registration Card, but I want to upgrade now!!

No problem. Since the upgrade checks for any previous version of Band-in-a-Box, you can order the upgrade even if you forgot to register!



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Vol. 3****The Blues  
Pianist****Children's  
Pianist****New Age  
Pianist****Bluegrass  
Band****Jazz Soloist  
Vol. 3**

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Each program contains piano music performed by world-class pianists, PLUS memos, trivia questions, biographies, Guess the Song games & more. They are ideal for learning to play piano, or for background music while you use other programs. Windows versions also display & print standard music notation & chord symbols for pieces. They are available for WINDOWS, MAC & ATARI, & are also available in Yamaha Disklavier & Roland SoundBrush format.

### NEW! The Blues Pianist™

**\$49**

Volume 1 (50 pieces - older styles) \$49 • Volume 2 (50 pieces - newer styles) \$49

Each volume contains over 50 great down-home blues piano stylings by top professionals! Playing in a wide variety of blues piano styles - Boogie Woogie, Slow/Fast boogies, jazz blues, New Orleans style, Chicago blues & more. These are the styles made famous by Pete Johnson, Albert Ammons, Jelly Roll Morton, etc. Hours of listening pleasure! Full of info & trivia on the great masters of piano blues. Slow them down & learn the licks! The perfect gift for any blues lover.

### NEW! The New Age Pianist™

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Over 70 "New Age" &amp; "New Age-Jazz" style piano pieces, played on MIDI keyboard by top performers.



A beautiful collection of solo piano compositions which draw their inspiration from the natural world. Full range of "New Age" piano techniques are presented: "ambient" performances in the style of George Winston & "New Age-Jazz" performances in styles of Chick Corea/Keith Jarrett. Includes song memos, biographies & information on important New Age musicians. Includes photo album of stirring nature scenes & real time piano score (notation in Windows version only). Over 3 hours of music!

### NEW! The Children's Pianist™

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Over 70 of the best-loved children's songs for listening &amp; singalong!

Lyrics to all songs displayed on screen in large type. Chords, lyrics & music notation. On-screen lessons explain the techniques of piano accompaniment. Examples of Alberti bass, embellishments, syncopation, stride style & many more techniques! Over 4 hours of music! Includes words & music for 70 songs: London Bridge, Camptown Racetrack, Home



Nearly 600 of the world's most popular classical piano pieces, performed by world class concert pianists!

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PLUS... Music Trivia Game, "Guess the Song", program notes, biographies, music dictionary (on disk) &amp; more!

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"Incredible...amazing...terrific...masterful...fabulous...love it...my favorite program!"

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Volume 1 (215 pieces) • Volume 2 (200 pieces) • Volume 3 (170 pieces) • Each volume \$49

We've added 170 wonderful pieces to The Pianist program. This magnificent library brings to nearly 600 the repertoire of classical masterpieces available in The Pianist series! Lots of new Chopin & Brahms, plus piano arrangements of orchestral favorites by Liszt and others. PLUS... New & revised program notes, biographies & dictionary (all on disk).

### The Jazz Pianist™

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This program makes it "too easy" to learn to be a great jazz PIANO player!

Top jazz/studio pianists play 60 jazz standards in a wide variety of styles.

Hear the music with CD-quality through your sound card or MIDI system. Most pieces have bass/drums as well as piano so you get a full sounding jazz trio for the tunes! Jazz Trivia game & Guess the Song game, program notes, biographies & music dictionary (all on disk).

### The Jazz Pianist Volume 2

Volume 1 upgrade - \$49 (requires The Jazz Pianist) • first time purchase: Volume 1 & 2 - \$98  
60 more fabulous jazz standards for Volume 2, complete with new program notes and biographies!

### The Ragtime Pianist™

**\$49**

Over 90 ragtime & early jazz piano standards, played on MIDI keyboard by top Ragtime Pianists... and featuring world-renowned Ragtime performer JOHN ARPIN! Hear virtuoso performances of every Joplin rag in this program, as well as many other rags, CakeWalks, waltzes & other Ragtime Era tunes by Eubie Blake, Joseph Lamb, Daniels and, of course, Scott Joplin.

### The New Orleans Pianist™

**\$49**

Over 60 "New Orleans Style" piano music standards, played on MIDI keyboard by top New Orleans pianists Henry Butler, Jon Cleary, Tom McDermott, Joel Simpson & David Torkanowsky playing a wide variety of New Orleans, R & B, Blues & Ragtime piano music.

### The Gospel Pianist™

**\$49**

Over 50 Gospel style piano pieces played on MIDI keyboard by top Gospel pianists Louise Rose, Davell Crawford, Henry Butler, Sam Berlert, Derrick Bethune, Joel Simpson & Jon Cleary. The "Gospel Piano" style underlies much of the blues, jazz & popular music played today.

### The Christmas Pianist™

**\$49**

This software includes great piano performances of over 50 all-time favorite Christmas songs and carols - ideal for listening or singalong! On-screen lyrics, notation & piano keyboard, piano notation printout, background playback, Music Trivia & Guess the Song games & more!

**NEW!**  
Ver. 3.5

**PowerTracks Pro™**

**ONLY \$29  
upgrade \$15**

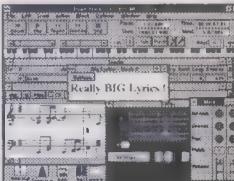
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"Solid sequencing at an unbelieveable price" Electronic Musician Sept. 93

NEW FEATURES in 3.5... Enhanced notation window (32nd notes, etc.)

- Karaoke window • Notation Scroll ahead • Notation clean mode
- Align music to click track • Force all files to PPQ option
- Improved hand splitting • Intelligent enharmonics

In versions prior to 3.5, we added major features like music notation, wave files, lyrics, chord symbols & printout. Now we've added many new features. We've added a big "Karaoke" Style Window to display lyrics. The notation is enhanced with support for finer resolutions like 32nd notes. You can align a rubato piece to a click track. We've enhanced the intelligent piano hand splitting routines. The enharmonics are intelligently chosen based on the chord symbols & more! Powertracks for DOS included FREE! (NOTE: DOS version doesn't support music notation or other graphical features).



### NEW! The Bluegrass Band™

**\$49**

Virtuoso live performances of 50 Bluegrass standards!

These MIDI files are great! As you listen to the tunes, you can single out any of the instruments using the on-screen fretboard display, tablature or notation. PLUS... Lots of Bluegrass pictures, bios, & trivia (all on disk) & much more. Our most "feel good all over" program so far. Includes: Wildwood Flower, Sally Goodin, Cripple Creek, Fire on the Mountain, Pigtown Fling, Red Haired Boy, Jesse James & many more!

### NEW! The Jazz Soloist™ Vol. 3

**\$49**

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The Jazz Soloist is a music program with professional jazz quartet arrangements. Each song features a great jazz solo played by top jazz musicians, as well as piano comping, bass & drums. Vol. 3 of the Soloist series features Latin, Blues, & Jazz Waltz styles. Includes Jazz Soloist program with MIDI files, & also files in Band-in-a-Box format. Sight-reading was NEVER so much fun before the Jazz Soloist series! (NOTE: Mac users get on-screen-notation only when running the files in Band-in-a-Box; Volumes work together or as standalone programs.)

### The Jazz Guitarist™ (Windows, Mac, Atari) \$49

A music program containing a huge collection of over 60 jazz standards, played on MIDI guitar by top jazz/studio guitarist Oliver Gannon

#### RECORDED IN REAL-TIME ON A MIDI GUITAR!

Hear the music with CD-quality through your sound card or MIDI system. Most pieces have bass/drums as well as guitar so you get a full sounding jazz trio for the tunes!

#### LEARN TO BE A GREAT JAZZ GUITAR PLAYER!

On-screen fretboard shows you exactly what notes &amp; chords are being played on the guitar. Slow down the performance or, better still, step through the music chord by chord, so you can learn every note as it's played!

#### PLUS MANY MORE FEATURES...

- Jazz Trivia game & Guess that Song game, program notes, biographies (all on disk)
- Over 60 Top jazz standards with complete guitar arrangements
- Listen to the music while you work in other programs
- Special support for Roland GS or General MIDI modules
- Standard MIDI files can be used in other programs or presentations
- Use your existing sound card or MIDI synthesizer

### Other products...

#### Multi MPU401 Driver for Windows 3.1 \$19

Windows driver that allows 10 programs to use the MPU401 at the same time.

#### NEW! Now for MAC too!

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mixing/editing of every feature of the Sound Canvas and other Roland GS cards/modules.

#### Roland Sound Canvas module (SC50) \$499

Newest, best sounding Sound Canvas ever (includes PowerTracks and SC-PRO FREE).

#### Roland Sound Canvas GM/GS SCM-15AT internal sound card \$399

Full MPU401 interface with 354 total sounds, 9 drum sets, 28 voice polyphony &amp; 16 parts. This is the ideal card for the musician. Free PowerTracks &amp; SC-Pro included.

#### Roland Sound Canvas General MIDI SCM-10AT internal sound card \$199

This card provides the 128 General MIDI sounds, 9 drum sets, 28 voice polyphony &amp; 16 parts. No GS features or higher bank sounds. Full MPU401 interface. Free PowerTracks &amp; SC-Pro included.

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# Realtime Internet Audio

## stunning applications for the very near future

*This is driving me crazy! I've been humming this tune for hours, and I can't remember who wrote it. In fact, I can hardly get past the insidious first few lines. Wait a second — it's about thiiiiis fast [tap spacebar], and the melody goes uuup and dowwwnn like this [draw on screen], and it's sort of an avant-synth-pop tango [check all that apply, click "Find"]. Cool! I think it's this one. [Click. Music plays]. No, that's not it. Let's try this one. . . . Hey, this is a great song too, and it sounds better on my speakers than on those half-broken, greasy headphones down at the record store. Jeez, there's an awful lot to choose from here. . . .*

by Joshua Salesin

**W**ith the help of some remarkable recent developments, you can listen to (and even purchase) music of your choice in real time at a level of quality approaching that of compact discs — all from the convenience of your Internet connection. In much the same way that water and cable TV are brought into your house, satisfying your needs with little more than a simple move of your hand, the Web is on the verge of offering up a plate so full of sounds you'll be pressed to find room for anything past the hors

# Realtime Internet Audio

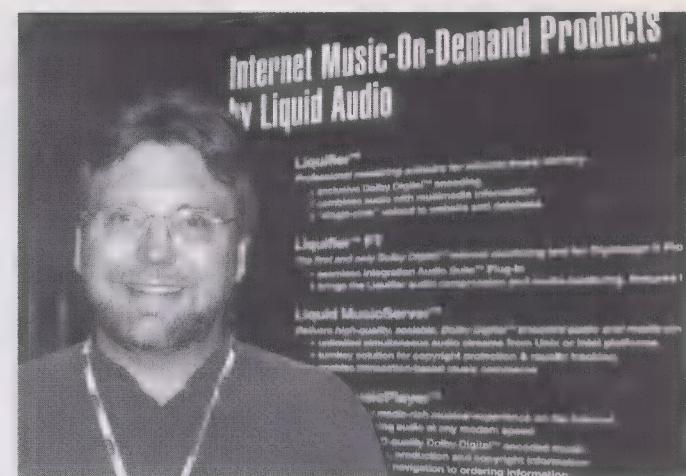
*d'oeuvres.* And while some of us will be using this technology to share our own music with the world, most of us are going to be living in a new world of music.

If you haven't yet had a chance to explore audio on the Web, you're in for a real treat: The days of waiting are over. Until recently, sound clips were posted on Internet servers for people to download and play locally from their computer. But the length of an audio clip and the way it's digitized determine how long you'll have to wait before hearing the music, and it can be a mighty long wait. To give you an idea, a four-minute tune at CD quality (44.1kHz, 16-bit stereo) contains about 176 kilobytes of data per second, which would take a standard 28.8 kilobit-per-second modem about two hours to download, given light Internet traffic. Even reducing the sound to telephone quality (11kHz, 8-bit mono) would require about 15 minutes. Not exactly instant gratification!

Needless to say, hearing music from the Web didn't start to become popular until new techniques to compress audio data were developed. With compression formats such as MPEG and µ-law (see glossary on

("streaming") audio was introduced to the Net and Web sites began to serve up instant music to their visitors. That four-minute tune, originally weighing in at over 42 megabytes, could now be compressed to under 1 meg and sent piece by piece to your 28.8 connection faster than you could listen in real time.

How does it work? Web servers stream audio by sending their data in a paced fashion, serving small bites to hungry mouths at a rate they can chew. In this fantastically scalable network of meals and mouths, bytes (literally) from different servers are sent, sorted, and eventually assembled on your plate. (Vegetarians beware.) You get the ability to hear music within a matter of seconds, sometimes in stereo, and even approaching CD quality (depending on your computer, the audio player software, modem speed, connection speed, and the current Internet bandwidth). And for the first time, realtime audio makes broadcasting live events on the Net a reality.



Gerry Kearby, Liquid Audio: "Within a year, entire record company catalogues may be available as samples on the Internet."

## Meet the Players

The sun is shining on streaming audio, and the companies developing the technology are popping up like crocuses in the spring. Some products, such as TrueSpeech, CoolTalk, and InternetWave, specialize in realtime Internet phone, chat, and conferencing abilities. Others, such as VDOLive, VXtreme, QuickTime TV, and Streamworks, set their sights on offering audio, video, and multimedia content like 3D environments, tours, and games. We'll explore recent developments like RealAudio and Shockwave, as well as new offerings from Waking Dreams and Liquid Audio.

The first sightings of streaming audio date back several years. Jon Luini, co-founder of MediaCast, a company that specializes in broadcasting live events over the Net, recalls, "Originally, if you had a fast enough connection, you could download a whole MPEG file and play it back in real time, but it wasn't until Netscape added the ability to pass that off to a helper application that it became possible to stream that data — first to Unix workstations, then to Windows, and then to Mac."

But things soon took a different spin as player applications were developed that didn't have to rely on Netscape's abilities but rather managed the audio data themselves. Luini notes, "Xing's Streamworks has been around for years, but RealAudio captured the world's attention."



Like a radio, TheDJ lets you listen to music in real time. You just need a 28.8kbps Internet connection and RealAudio 3.0. If you've produced a CD yourself, they'll even upload a song and promote it for free.

page 23), music files could be offered at a fraction of their original size, somewhat easing the frustrations of listening to the Web through your computer. However, the often lengthy wait combined with the confusing configurations of helper applications required to play the music wore away the novelty, leaving only the most dedicated listeners.

All this changed nearly overnight during the spring of 1996, when realtime

the details of creating, posting, and playing streaming audio in a future article. (For those of you saying, "Let me at it, now!" check out the "Click Here" sidebar on page 26.) The technology has evolved at an incredible rate, and as it continues to speed onward, it's bound to break a few sound barriers. In this article, we'll look more closely at some of the new technologies and their implications as we prepare for the sonic boom.

## RealAudio: Now More Real

With the magic combination of good marketing and a product that worked well and was easy to use, Progressive Networks' RealAudio became the springboard

that landed music from the Web onto computers world-wide. Its ability to stream not only audio, but live audio such as radio station and concert broadcasts, was key in securing both corporate and consumer support, and thus its dominant position in the market today.

Not only is RealAudio currently the most popular way to make audio accessible on the Web, it's one of the easiest. The sound quality has significantly improved with the recent 3.0 release. A quick trip over to <http://www.realaudio.com> can land you a free encoder, player, and pages full of tips for creating Web audio content. You'll also find plenty of links to sites showing off the RealAudio technology.

To present your own content using RealAudio, you'll need to encode the music, post it to a Web site, and pick up

a limited version of realtime audio from their Web pages, free of charge.

Danny Johnson, special projects director at IUMA (the Internet Underground Music Archive), reveals, "Since we added RealAudio, the number of people calling up to order stuff has tripled. It's like having a record-store listening station at your own computer." Although IUMA has been posting audio clips since the dark ages of the Web (1993), the recently added ability to hear audio in real time has IUMA's co-founder Jeff Patterson agreeing: "With the addition of RealAudio, our site's become much more accessible. Initially, we were so worried about being hi-fi and having the best quality. Then we took the step toward being as accessible as possible by using a system where people could hear the music quickly and

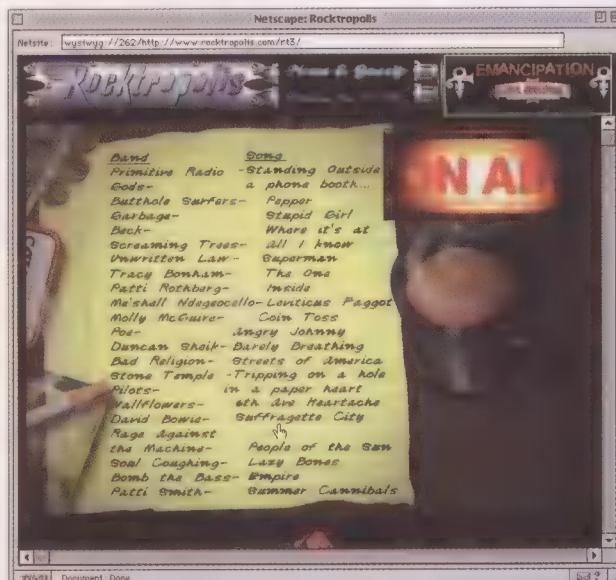
easily, and found that it works a lot better that way." [Ed. Note: See our cover story on IUMA in the July/Aug '96 issue.]

Now, as the bands play on, RealAudio is headed in new directions, offering the ability to stream all sorts of data types, including animation, video, graphics, 3D, MIDI — nearly anything you want. Mika Salmi, director of entertainment and broadcast marketing at RealAudio, explains, "The idea is that you'll only need one server and one standard

client to be able to receive everything, because it'll all work on the same protocol. Just like the http protocol — without that, the Web would be a mess. Http was for graphics and text, and this is for streaming multimedia."

### Shockwave: More than Music

A good example of a technology that's already offering interactive audio and multimedia is Macromedia's Shockwave. Ben Dillon, sound products manager at Macromedia, says, "We wanted to have a scalable solution, so if you just want to post some audio on the Web, we make it easy enough for you to do that in ten minutes. If you want



Rocktropolis pairs fantastic clickable 3D graphics with streaming audio to deliver up-to-the-minute news and music.

RealAudio server software, which enables the audio to stream, rather than download, to your listeners. Using this software, a single audio file can stream to hundreds of people at the same time. The software also automatically determines the most appropriate quality to send to a listener based on his or her connection speed. Originally, these capabilities were offered along with a price tag that only a corporation could afford. More recently, RealAudio recognized the needs of smaller artists and introduced a five-stream server solution for several hundred dollars. Now they've taken it one step further by offering http-based streaming that allows anyone to serve up

## Glossary

**ADSL:** Asymmetric Digital Subscriber Line. A telephone-line-based modem standard that is capable of transmitting from 1.5Mbps to 9Mbps downstream and from 16kbps to 640kbps upstream, depending on line distance.

**bandwidth:** Amount of data that can travel between two network points at any given time (e.g., from server to modem).

**browser:** A specialized program enabling reception of information from the Web.

**client:** A software application that runs on a local machine (your computer) and extracts a service (from a server) across a network.

**compression:** Data reduction. Used to decrease file size and transfer time.

**CODEC:** A software program (or hardware device) used to compress and decompress files. (Hence "CO" and "DEC".)

**helper application:** A program that launches automatically, handling information from an incoming file whose format the browser does not support.

**HTTP:** Hypertext Transfer Protocol. A protocol that determines how text and graphics are transferred from Web pages.

**ISRC:** International Standard Recording Code. A standard label the recording industry attaches to its products offered for sale.

**kbps:** Kilobits per second. Used to measure the transfer rate of data.

**lossless compression:** A technique that reduces the size of a file without sacrificing any of the original data. (When expanded, the compressed file becomes an exact replica of the original file.)

**lossy compression:** A technique in which some data are deliberately discarded to reduce the size of the file. (When expanded, the compressed file is lower in quality than the original file.)

**MPEG:** A standard data compression scheme for digital audio and video based on perceptual coding, named after the Moving Picture Experts Group. See perceptual coding.

**multicasting:** A protocol that sends information from one computer to multiple receiving computers within a given area. Similar to a broadcast model.

**perceptual coding:** A compression scheme that throws away audio frequencies that are masked by other more dominant frequencies, and thus not perceived by the listener.

**plug-in:** Software that extends the functional capabilities of a host program.

**protocol:** A set of standardized rules for exchanging information between computers over a network.

**scalable:** Able to offer various responses (different file types, for example) depending on the needs and abilities of the receiver.

**server:** 1) Software that allows a computer to offer a service to another computer. 2) The computer that houses information that others access via the Web.

**streaming:** Transfer of audio or video data in a way that enables multimedia content to be experienced in real time rather than requiring the entire file to download first.

**µ-law:** The international standard telephony-encoding format, used to compress audio before posting it to the Web. Pronounced "mew-law."

# Realtime Internet Audio

to create an entire interactive environment in Shockwave, you can do that too, but the requirements are different." In fact, anything you've seen on a CD-ROM can be created for the Web, although people's ability to experience it is severely limited by the speed of current Internet connections.

Prepare to get shocked at <http://www.macromedia.com/shockwave>, where you'll find the latest plug-ins and a wealth of information free for downloading, letting you experience what hundreds of Shockwave sites have to offer. To roll your own, you'll need to pick up Macromedia's SoundEdit 16 software (just under \$300) for Macintosh or a free plug-in (available on Macromedia's Web site) for PC. SoundEdit 16 enables you to export your tunes in the Shockwave audio format; it also provides an array of audio editing abilities.

In either case, with Shockwave file in hand, you'll be able to post and stream audio from your page free of charge, limited only by your server's capabilities. "We wanted to provide a solution for people to have streaming audio on the Web without a huge investment. We think it's just another part of multimedia," Dillon says. "In fact, Shockwave is the perfect playback mechanism for all media types, whether it's QuickTime or another format, because we're going to support it."

Not only does Shockwave have the ability to put some of the best-sounding audio

to date on the Web, it has a fully customizable front-end player. This lets you design controllers that go beyond the standard Start and Stop tape-recorder-like functions. You could, for example, program text and graphics to download when a specific music request is made, trigger new events — such as an image or text — at specified times, and create completely original graphics for the player itself.

## SoundStream Wakes the Web

When talking about putting controls into the hands of the people, there are few companies more interested in or closer to making it happen than Waking Dreams. Brian Balthazar, director of audio technologies, remarks, "As soon we saw the Netscape browser, I realized there was a big deficiency in that there wasn't any realtime audio."

At the time, Balthazar was working in the satellite broadcasting and cable arena, and saw the need for tools that could send and receive audio in real time, within the current bandwidth limitations of the 28.8 kbps modem. "When they started back in '87, the MPEG specification was conceived specifically for CD-ROM," he says. "With newer compression technology, like MPEG Layer III, you have the ability to produce streams as small as 16 kbps and 8 kbps, which facilitates network transmission." While this may seem

unnecessarily low for the standard 28.8 kbps modem, Balthazar explains, "You're not getting all of that at any given time. A lot of things determine throughput, such as all the different paths that are separating you from the data. Chances are that with a 28.8, even at best case, you're getting maybe 18 kilobits per second, and probably only 14."

While other companies stream audio using proprietary compression schemes, Waking

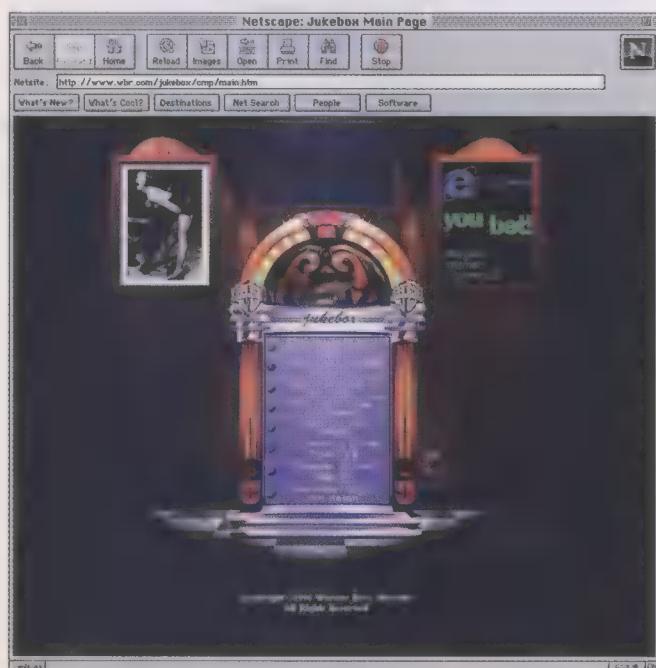


*Jeff Patterson, IUMA: "Artists don't have to become superstars anymore to make money off music. You just have to create one digital master that can be transmitted millions of times."*

Dreams saw that MPEG compression offered distinct advantages. "What you really want is to provide a software solution now and be able to provide hardware acceleration down the road — both from the authoring standpoint and the player standpoint," Balthazar asserts. "Because the entertainment industry has so much invested in MPEG in terms of equipment and infrastructure, that said to me it was going to be the compression standard that delivered all of these things."

After creating Kauai Media's much applauded Mac-based MPEG encoder and player software, Balthazar began developing a new streaming-audio-on-demand solution, called SoundStream, for both Internet and CD-ROM use. Enjoy the ride as you enter one of the more interesting (and provocative) sites on the Web at <http://www.wakingdreams.com>. Here you'll learn (among other things) the true meaning of SoundStream — a seemingly innocuous application with some very big implications.

Developed for Macintosh, with Windows and Unix releases to follow, SoundStream can MPEG-encode CD-quality sound in a wide variety of bit rates and then stream that audio across the Net, with the option for listeners to save it to disk in real time. Aware of the copyright issues this creates, Waking Dreams has developed a "watermarking" (file identification) technology in hopes of establishing a precedent for an audio commerce system on the Net.



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# Realtime Internet Audio

while protecting the copyright of musicians and record labels.

"Our ultimate goal was to put something that answers the whole equation into the hands of musicians," Balthazar concludes. "Something that allows people to create all the content they need in all the bit rates, and that transparently delivers it to the end user, because all the end user cares about is getting the music and either playing it in real time or recording it to CD." To that end, SoundStream offers plug-ins for Netscape, Explorer, and Digidesign programs.

In fact, SoundStream is only part of the picture. It works in conjunction with a very slick front end called Manifesto that was developed by Waking Dreams' founder and CEO Todd Rundgren. [Ed. Note: See interview on page 34.] Manifesto is a music browser that lets you locate music by such characteristics as style and tempo as well as more subjective factors, then customize a virtual music collection. From an entrepreneur's point of view, Manifesto enables you to create a virtual record store or offer personalized



Jon Luini, MediaCast: "The Internet can't support all this data. Multicasting is a solution. It's really a question of when and how rather than if."

Net-radio services, complete with detailed accounting of all transactions.

## Click Here

Ready to check out some realtime Internet audio? Type these links into your Web browser. For clarity, we've listed the complete path to the page with the goods, but you can save yourself some typing by entering just the home page's URL (for example, <http://www.wakingdreams.com> instead of <http://www.wakingdreams.com/ni/index.html>). Some browsers, such as Netscape, make it even easier: Merely typing "companynname" (no quotes) will take you to sites using the standard URL format <http://www.companynname.com>. For the fewest keystrokes of all, stop by the *M&C* site (<http://music-and-computers.com/>) and punch up our "music links" page.

### STREAMING AUDIO SOFTWARE

**Apple Computer** (QuickTime TV): <http://qtc.quicktime.apple.com/>  
**CoolTalk**: <http://www.insoft.com/products/products.html>  
**DSP Group** (TrueSpeech): <http://www.dspg.com/internet.htm>  
**Liquid Audio**: <http://www.liquidaudio.com/>  
**Macromedia** (Shockwave): <http://www.macromedia.com/shockwave/>  
**Progressive Networks** (RealAudio): <http://www.realaudio.com/>  
**VDO** (VDO Live): <http://www.vdo.net/enhanced.html>  
**VivoActive**: <http://www.vivo.com/vivoactive/>  
**Vocaltec** (Internet Wave): <http://www.vocaltec.com/iwave.htm>  
**Vosaic**: <http://choices.cs.uiuc.edu/Vosaic/Vosaic.html>  
**Voxware**: <http://www.voxware.com/>  
**Vxtreme**: <http://www.vxtreme.com/products/index.html>  
**Waking Dreams** (SoundStream): <http://www.wakingdreams.com/ni/index.html>  
**Xing** (Streamworks): <http://www.streamworks.com/>

### DEVELOPER INFO & AUDIO HELP

**Audio FAQ** (Making Internet Audio Files): [http://sol.ultralab.anglia.ac.uk/pages/schools/online/Using\\_Audio/](http://sol.ultralab.anglia.ac.uk/pages/schools/online/Using_Audio/)  
**Fraunhofer-Gesellschaft Research Institute audio and multimedia department** (key developers of MPEG audio CODECs and realtime signal processing algorithms): <http://www.iis.fhg.de/departs/amm/layer3/index.html>  
**MediaCast software configuration helper page**: <http://www.mediacast.com/Software/>  
**MPEG**: <http://www.powerweb.de/mpeg/>  
**Multicast solution vendor**: <http://www.icastcom.com>

### RealAudio content creation guide:

[http://www.realaudio.com/help/ccguide\\_index.html](http://www.realaudio.com/help/ccguide_index.html)

### RealAudio products/players:

<http://www.realaudio.com/products/index.html>

### Shockwave developer:

<http://www.macromedia.com/shockwave/developer.html>

### CONTENT LOCATORS

**RealAudio sites listing**: <http://www.imecast.com/sites/index.html>

**Shockwave gallery**: <http://www.macromedia.com/shockwave/epicenter/index.html>

### OTHER COOL SITES

**Addicted To Noise**: <http://www.addict.com/>

**Aerosmith**: <http://www.eff.org/virtour.html>

**American Recordings**: <http://americanrecordings.com/>

**Audio Highway**: <http://www.audiohwy.com/>

**David Bowie single**: <http://www.davidbowie.com/lies/index.html>

**DirecPC** (Internet Delivery System): <http://www.direcpc.com/>

**DMX**: <http://www.dmxmusic.com/>

**Geffen Records**: <http://geffen.com/>

**Indy labels on the Web** (massive list): <http://www.kathodery.org/music/labels.html>

**Jazz Central Station**: <http://jazzcentralstation.com/>

**Kaleidospace**: <http://www.kspace.com/>

**MediaCast**: <http://www.mediacast.com/>

**N2K entertainment**: <http://www.n2k.com/n2kenter.html> (lists various sites)

**Rocktropolis**: <http://www.rocktropolis.com/rt3/>

**Ultimate Band List**: <http://www.ubl.com/>

**WebTV**: <http://www.webtv.net/HTML/home/about.html> or <http://www.webtv.net/>

### Liquid Audio: High Watermark

Wondering if we're really ready for this?

Liquid Audio's Gerry Kearby thinks so. After years of experience building high-end sound components for the pro-audio, television, and film industries, he started thinking about possibilities for the Web. "I came to the conclusion that the music industry needed a total solution to the problem of music distribution," says Kearby. "I decided to take the skills and tools we had developed in the pro audio industry and move them into the semi-pro or consumer market. So I set about dreaming up an end-to-end solution, the first one being a mastering solution that would be easy to use but unfold to give more complex and precise compression controls."

Set your sail for <http://www.liquidaudio.com> to get your free Liquid MusicPlayer, which allows users to view art, lyrics, credits, and copyright information while listening to high-fidelity music from the Net. To offer your own tunes, you'll need to spring for the Liquid MusicServer, which could cost a few farthings depending on your streaming needs (the price was not set as of this writing). Using a proprietary version of Dolby compression technology, the Windows-based Liquifier lets you record, edit, convert, compress, and post music at various data rates, along with graphic and text information. A Liquifier plug-in is available for Digidesign's Pro Tools audio editing environment.

The process promises to be quite simple while remaining uniquely powerful. Kearby explains, "Once you've recorded the music and input all the media information, the Liquifier lets you preview the song, so you can listen to how the data compression is going to work with the various presets. Then there's a button that says

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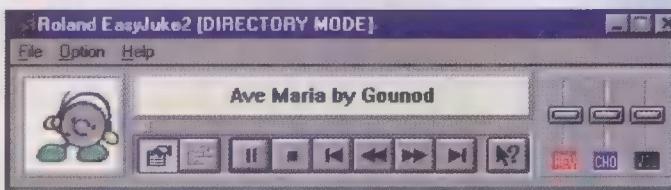
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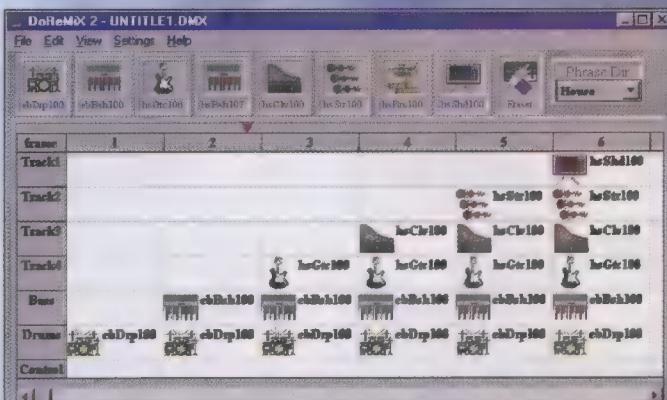
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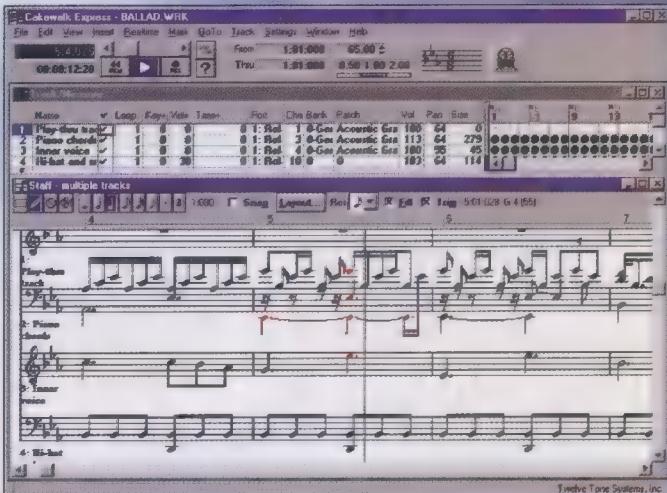
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# Realtime Internet Audio

'publish.' Once you've configured the software with the server name and database name, it calls the server, uploads the songs, and back-ends it into the database, so you don't have to know anything about it.

"We hope to have a record-company-in-a-box software solution that, for under \$1,000, will let musicians master their songs, put them up on the Net, and have secure shopping-cart transactions to sell their music."



Mika Salmi, Progressive Networks: "Some big artist is going to sign their new deal and say, 'You can have all the traditional distribution channels, but I get distribution via the Internet.'"

Because they offer a virtual package complete with music, graphics, text, and various product codes, similar to the traditional way of selling music, Kearby believes Liquid Audio will provide the tools for a new way to publish music. Not only does it offer excellent sound quality and copyright protection, it also handles secure management and tracking of online purchases. Together with some of the better known Web sites such as N2K's Jazz Central Station and Rocktropolis (see the "Click Here" sidebar on page 26), Kearby hopes Liquid Audio will "remove the barriers to music on the Internet and provide unlimited access to vast libraries of music titles while protecting the rights and integrity of the artist."

## So What's the Catch?

By this point, you're probably either rushing out to get connected to the Internet or laughing hysterically in disbelief. While these new streaming audio technologies are definitely pushing through old boundaries, offering ground-breaking improvements over versions only a few months older, they're also pushing against



The Liquid Audio system can pour a variety of information into the audio stream, including lyrics, album credits, and artwork.

some very real barriers. In fact, these new technologies are exciting more for what they might bring than for what they are able to deliver now, partly due to factors outside their control.

"Technically, you can do it today, which is why it's so seductive," says Jim Griffin of Geffen Records. "But that's misleading to the public. They're led to believe it really

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*Multimedia World, 4/96*

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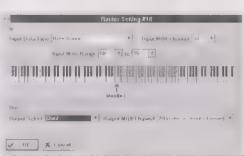
- Electronic Musician, July 1994



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## Realtime Internet

exists. Geffen would very much like to see all of this happen, because matching supply to demand is very costly. Why would we deny it if it were there? But it's not. My ears don't think it's there." What Griffin is exposing is that these technologies don't technically deliver CD-quality music, even given optimal streaming conditions. Although the audio encoders do a surprisingly good job of determining which frequency bands to cut from the music, they all discard large amounts of data in order to create compact files that can be transferred and decoded quickly.

While improving the way the audio is encoded is a key factor, improving the way it gets from the server to the listener's player is equally important in determining the end result. There are several Internet transmission protocols, and each approaches error correction differently, with correspondingly different audio results. Transmission protocols need to become more sophisticated to handle the potential increase in demand as well as the preferred increase in quality.

"Everyone's realizing that the Internet can't support all this data being transferred," says MediaCast's Jon Luini. "So we have to look more at multicasting, a network between a series of large Internet Service Providers that supports broadcast feeds and is open to all different types of data."

As quickly as computer technology changes, some things can't move fast enough to satiate our audio-on-demand desires, and bandwidth is one of them. As current modems crawl toward higher transfer speeds, other options such as cable modems, satellite technology, and the phone company's ADSL technology look increasingly appealing in their promises to deliver a wider pipeline. Mika Salmi notes, "Over the last few years, you've heard of but haven't actually seen that much activity. But I think now you're going to see people really putting their heads into it. Depending on where you are, it'll be a combination of satellites or cable modems."

### Where the Money Goes

As increasingly powerful and better-sounding software develops and improved delivery mechanisms become established, a whole new set of possibilities for

READER SERVICE NO. 117

delivering and publishing music will evolve. While some solutions are geared toward broadcast, others are focused on the digital distribution and sale of music. Therefore, people have different concerns about how the technology will be used — to improve the quality of what a user can experience, or more likely (if we look to radio and cable television as examples), to simply increase the quantity of what is offered. In either scenario, people are realizing that several important issues need to be addressed.

"With electronic music-on-demand, you are in effect shipping a digital master to the home," says Liquid Audio's Gerry Kearby. "So you've got to come up with a

exact mechanism to forward it to BMI, ASCAP, and the Harry Fox Agency so the royalties can be collected."

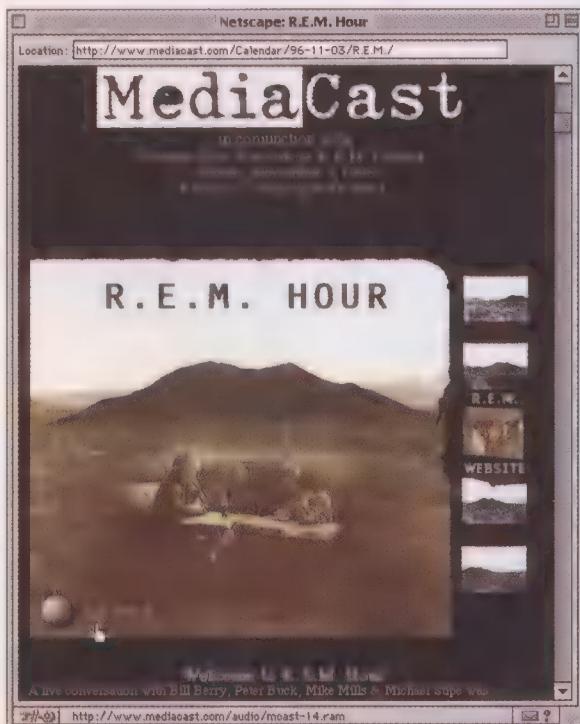
Here's how it works: "When you master the stuff, the mastering person's name along with the UPC code and ISRC code is watermarked into the sound digitally," explains Kearby. "When the sound is purchased, the server's software watermarks the sound with the buyer's name. Once the transaction software has notified us that a transaction has taken place, our server generates a 'media voucher,' which has a key in it. The encrypted voucher is sent to the player, gets signed and returned to the delivery manager, which delivers the sound. Now the sound is keyed to that exact player."

"When you download the music, you've got a digital master you can play on your own computer as many times as you like. But if you copy that sound to another computer, the player on that computer doesn't have the key, so it can't play it. If you copy the player to the other computer, the player will know it's been copied to another computer by looking at the system disk, and it will throw away all its keys. Further, we have software that writes the music to a CD-R. It knows when the song was successfully written to a CD and changes the encryption key so it can't be written to a CD again."

Brian Balthazar notes,

"Once the signature is in there, you can have a count, so you could have the music play back any number of times and then shut down. We realized that to make it a viable medium, you have to have that in place."

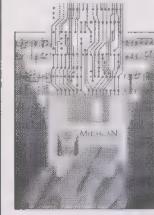
Some people feel it's a mistake to sell music that is inherently lower quality and more limited (by such encryption keys) than the CD recordings that are currently available. "The bandwidth and methods of distribution are not here today to accept this as our digital future," Jim Griffin states emphatically. "We're pushing things. We



MediaCast used streaming audio to bring R.E.M. fans around the world a live conversation with the band. Listeners were also treated to unreleased tracks.

way to prevent illegal duplication. And you have to protect the copyright of the individual property owner, so you're not just building this big bootlegging tool. We made sure our mastering software had the ability to include all the copyright information, the various product codes, and the other kinds of unique identifiers the industry attaches to its products. When you buy a song from a Web site, we generate a copyright log and a hit log. It's the legal obligation of the person who sold the song to pay the royalties, so we're providing the reporting structure that gives them the

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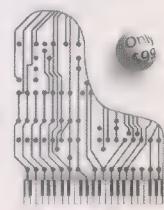
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# Realtime Internet Audio

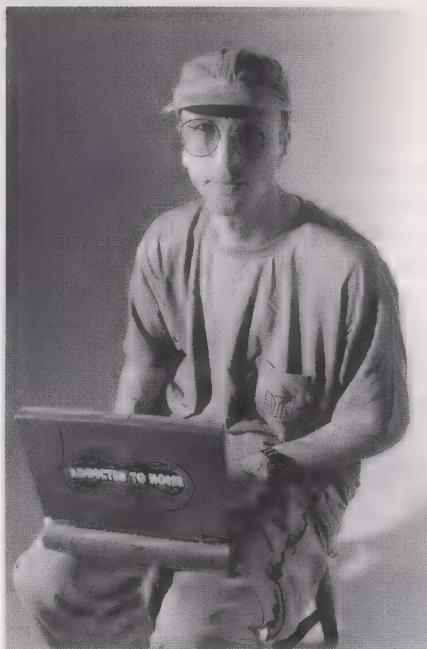
should enter the digital future in a way that makes things sound better.

"CDs in the store are not encrypted. People are going to get the music somehow — off the radio, from a friend, or in a store — but if it's encrypted, the product becomes less useful and harder to sell. The origins of the industry are to persuade people to buy it, not compel them. Why do we expect this new technology to deliver an unattainable level of protection? It's a little greedy thinking that we can put a lock on this property."

But most streaming audio developers aren't worried about unauthorized copying of music. Ben Dillon of Macromedia says, "The cat's out of the bag. There are hesitations, but it's going to be one of those things like videotape: The movie industry thought videotape was going to destroy them, and it did nothing but give them another channel to make tons of money. Audio on the Web is the same. If you have the rights to do it, it's a great marketing tool, and I think will lead to more CD sales."

## Your Very Own Radio Station

Some of the people most interested in taking advantage of the new possibilities



*Michael Goldberg, Addicted To Noise: "It took at least five years for the CD to make serious inroads. I think Internet audio is going to require a similar process."*

to sell music globally are the musicians who don't enjoy the benefits that a record label strong-arm can offer. Most of us, in other words. For most artists, the Web is

the greatest calling card they've ever had. Todd Williams, sales and marketing director at IUMA, explains, "Fewer than one percent of musicians are making enough money to live off their music. The other 99% are glad to have an opportunity to get their stuff heard. Traditional distribution is a system that was set in place because the economics of music were different. The economics are changing. It's now becoming possible to get access to large audiences very economically. Technology is creating opportunities for artists to cut out the people between them and the end user. And in the process of doing that, the whole music industry is in an upheaval."

Artists are closer to having an alternative to the elusive record deal than they've ever been. IUMA co-founder Jeff Patterson notes, "Artists don't have to become superstars anymore to make money off music. We see the emergence of a middle-class musician where the cost of entry is fairly low, since you don't have to create any physical product. You just have to create one digital master that can be transmitted millions of times." ▶

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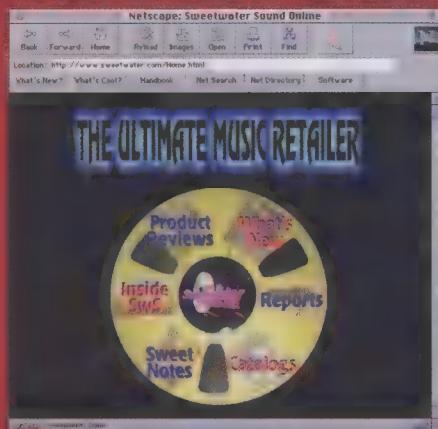
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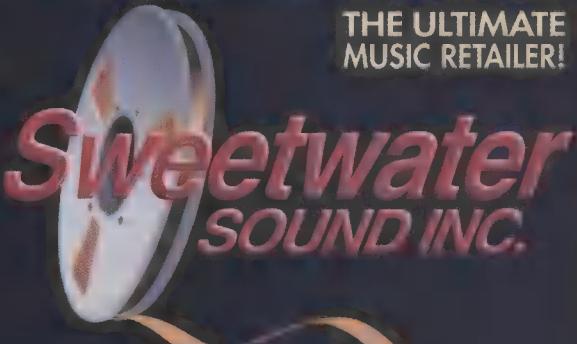


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# Realtime Internet Audio

Mika Salmi, who comes from a record industry background, predicts we may even see well-known artists reserving their rights to the Web, in part because of the creative control it can offer. "Some big artist is going to sign their new deal with Sony or Warner and say, 'You can have all the traditional distribution channels, but I get distribution via the Internet.' They can get a much higher royalty income. They can control it. They can get creative on the Web. They can do all kinds of things." If the Web forays of Aerosmith, David Bowie, and, more recently, Sammy Hagar are any indication, Salmi will no doubt be correct.

However, individual musicians without a big label deal may find it difficult to get a storefront that people will find on the Internet. They don't have the powerhouse marketing and distribution or the tight connections with the press that the record companies have. Michael Goldberg, editor and publisher of the online rock 'n'



*Brian Balthazar, Waking Dreams: "In this new context, record companies haven't spent a nickel to deliver the content, and it's going to be much harder to justify the prices they had before."*

roll magazine *Addicted To Noise*, remarks, "The average music fan only becomes aware of a small number of the thousands of albums that get released every year. As an unknown artist, your first challenge is to figure out how to get your music out there so people know it exists, so they can make a choice as to whether they even like the music or not. Even with all of the new possibilities, you still have this problem of getting anyone's attention."

While this will certainly open up new opportunities for people with clever guerrilla techniques to get the word out (or browser software specialized to match audiences to music), it also seems likely alternate distribution channels will arise. "I don't think artists will want to go completely alone," says Salmi. "They'll want to have some sort of forum or work with some company online." Already, companies such as IUMA and Kaleidospace offer an established storefront to otherwise lesser known artists.

"We're finally starting to realize the vision of being an alternative music distribution mechanism for a lot of these bands," says IUMA's Jeff Patterson. "Waking Dreams has spoken about a mechanism to stream audio direct to CD. When you look at the stuff they're doing, you get a sense that it's going to become a reality very quickly. With companies dedicated to that, it lets us focus on the content and license the technology." ►



## Todd Rundgren's Waking Dreams

INTERVIEW BY DAVID BATTINO

ward, we hooked him up with Eric Bell, M&C's MOD columnist. Eric plans to share his findings shortly.)

We also got a peek at *Manifesto*, Waking Dreams' interactive multimedia database, and *SoundStream*, their realtime audio delivery software. As we listened, they shrunk a 5Mb audio file down to a few kilobytes with very little perceptible loss of quality. To top it off, we had a fascinating discussion with Rundgren on the role of audio in interactive media.

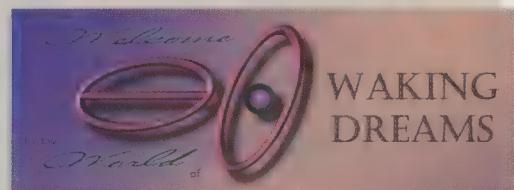
**You've said the business of Waking Dreams is to realize dreams intact. Is your role to generate the whacked-out ideas that other people bring to fruition?**

It's no longer my responsibility to come up with all the

whacked-out ideas. We look at Waking Dreams as kind of a home for whacked-out ideas — the wayward ideas' home. They're wacky in the sense that we don't like to do the same work other people are doing. I come from an artist's background, not an engineer's, and I've always had a criterion that transcends my understanding of the limitations of the platform. So the difference we add is a certain kind of attention to key elements of the problem that turn it into a unique experience.

In *The Individualist* [Rundgren's new enhanced CD], we could have used an off-the-shelf paradigm like everyone else did: "Aw, let's just do an electronic biography." But I looked at the enhanced real estate as an opportunity to expand the experience of the statement the music was making, rather than have it be "behind the scenes" or anything like that. Having that criterion in the first place required everything to rise to another level. In other words, we have a degree of interactivity.

The problem with most products that claim interactivity is that they push all the work they were supposed to do off onto the user. They just shovel all the pictures and sound clips and stuff in there, and it's up to the user



*The Waking Dreams logo is modeled on a pair of sunglasses owned by Todd Rundgren. For more alternate realities, visit <http://www.wakingdreams.com>.*

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Dvorak, *Symphony No. 9 in e minor, "From the New World", op. 95*

Tchaikovsky, *Symphony No. 6 in B minor, op. 64*

Mozart, *The Marriage of Figaro Overture*

Weber, *The Free-Shooper Overture*

Suppe, *Light Cavalry Overture*

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# Realtime Internet Audio

Gerry Kearby adds, "We've seen that the strongest interest is from the independent record labels and people who don't enjoy the great distribution advantages that the bigger labels do. It's going to let record companies sell back-catalog stuff without having to create compilations and build inventory and try to make shelf space for it. I'm talking to at least three organizations that are digitizing bucketloads of content. It's not inconceivable that within a year there will be entire catalogues from the major companies available as samples on the Internet."

## Not Dead Yet

Record companies are doubtlessly going to be utilizing the Web's capabilities to their advantage. "Over the last nine months they've become used to the concept of the Internet and what it offers," says Salmi. "When RealAudio 3.0 came out, rather than being scared, they embraced it." Geffen's Jim Griffin concurs: "I don't fear anything about the digital future. We really stand to profit in this. It'll help the artists cut through the clutter of the marketplace." Marc Geiger of American Recordings (and operator of the Ultimate Band List Web

site) agrees. "The Web hasn't replaced the CD. People aren't throwing away their stereos. We see it as a way to get exposure and get the music into the public's hands. We look forward to working within the new distribution channels because if you know what to do with them, you'll be able to reach a much larger audience, and that's the ultimate goal."

And while the new technology will most certainly be used to sell music online, Griffin adds a cautionary note: "Let's not stumble in our haste to sell the people a bill of goods. We ought to settle down and figure it out before offering it up. It would be great to have no more returns, no more out-of-stock signs, no more out-of-print items. I could take a several-million-dollar distribution budget and use it [in these new ways]. I wish it were happening today, but there's more work to do to make it better. The only thing we're afraid of is confusing rather than enlightening the consumers; a confused marketplace doesn't help anyone."

In the meantime, record companies will most likely use the Web to monitor what is popular, as a testing ground for their bands, and as a way to discover new artists. It seems almost certain they'll find a way



Jim Griffin, Geffen Records: "This is a really promising future. But it's the right time to be thinking education and the wrong time to be thinking profit."

to use audio-on-demand and the new digital music distribution possibilities to increase the sales of artists both past and present. Says Gerry Kearby, "Basically, my pitch to the record industry is, 'Hey, why not sell that old song for a dollar? It's a good way to build intelligent compilations."

## Digital Distribution

While we're not yet there, the possibilities signal some very real changes for the

# Todd Rundgren's Waking Dreams

to make sense of it. My criterion is, "Hey, I'm an artist. If I have something to say, I'd better get out there and say it." I allow people to view it from a different side of the room, get underneath it or above it, speed it up or slow it down. But it can't be an empty vessel. Our first criterion was for users to be able to put the disc in, and to — with a minimal amount of work — be entertained or informed. You give them options, but it's only options, not a requirement.

One of those options is passivity. Not necessarily bolted-down-to-the-chair passivity, but the art and presentation should be compelling enough that they don't feel like they have to do anything. The suspension of disbelief takes over and they are in your world. The trickiest thing to figure out is, what happens when interactivity is an integral part of that presentation? At some point or another, there's going to be a requirement of human intervention for things to gain any character.

***It must be tricky to do that in a friendly way. When you run your ATM card through the reader in the supermarket and look away for too long, it beeps at you to bring you back.***

That's an interesting phenomenon, although that demand for interactivity pushes my philosophical buttons. The idea that at some point things would grind to a halt, that you could not go any



The Individualist, Todd Rundgren's new enhanced CD, uses daVR technology to provide virtual reality experiences like a Doom game in which you can blow away overbearing talk show host Rush Limbaugh.

further without some input . . . that would have to be a real special circumstance.

How do you integrate the opportunity to interact into the presentation so it doesn't look like wings on a pig? It should be seamless in the sense that comedians have interactive performances with their hecklers. If a comedian isn't doing well, you expect somebody to step up and say, "Hey, you suck!" The ground rules for that particular presentation allow for that level of interactivity and no one thinks there's anything unusual in that. Then again, symphonic performers rarely expect that somebody would stand up in the middle of a performance and scream, "You suck!" at the conductor.

I've always felt there was an element of interactivity in most things; it's just the ease with which you can access it. For instance, if you were good enough and you were given enough information, you could splice movies together on the fly, just by hitting the channel-select button on the television. You know that game where you find two talking heads on adjacent channels and flip back and forth? You can almost get them to start delivering weird dialog. That's the kind of thing a lot of people think interactivity is supposed to bring: the ability to recognize those splice points and facilitate that for you. As it becomes easier, more integrated into the presentation, that's when people start calling it interactive, even though

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# Realtime Internet Audio

future, as Todd Williams explains: "As soon as electronic commercial music distribution is a reality, the costs of distribution are going to go way down. Traditional music stores are going to be severely impacted. People won't have to go to the record store when they can sit at home and look at album covers on the television and get a free taste of the music. Artists will give away free songs, because if people get a chance to hear something, the probability of them buying something goes way up. If labels don't have to create a plastic thing and ship that to a physical place with a physical overhead, they're able to cut out a lot of costs. When you do that, you can bring the price of the product down, and then all of the sudden the competition between traditional distribution and the new method of delivery will basically put the traditional method out of business. The Block-busters have been slow in changing over to the Web because they have a tremendous investment in the old system. You think buggy whip makers stopped making buggy whips as soon as cars showed up? No! The economics books are full of buggy whip makers that just didn't get it." Of course, CD prices didn't fall as promised

after manufacturing costs dropped, so it remains to be seen how much the economics will really change.

"Realistically, I think the process will die hard," predicts Brian Balthazor. "The record companies will continue to leverage their advertising dollars. They were able to justify what they're doing because there was ultimately a piece of plastic that was delivered and they could mask it to make it look like it costs something to make, but most people realized it didn't. In this new context, they haven't spent a nickel to deliver the content besides the cost of the server, and it's going to be much harder to justify the prices they had before."

Jeff Patterson comments, "If the retail outlets tailor their business model to fit the new industry, they should be okay. They could provide a service where if you want a hard copy, you could go in and they could create the CD for you right there."

## Into the Crystal Ball

One thing is certain: Nothing changes faster than the electronics, entertainment, and communications industries. Within the next year, we'll see more companies offer new products that will not only sound

better and remain easy to use, but will also be more personalizable and uniquely engaging. As the market becomes flooded with increasing content, these products will serve as our new filters.

For example, Jeff Patterson says, "We're developing this IUMA radio console application that will allow you to tune into different genres that are customized to your personal tastes, as well as offer feature shows with celebrity DJs. We're trying to bring traditional models to our site to make people feel more comfortable with the newer technologies."

We're also likely to see the equivalent of "audio postcards" from Waking Dreams, as Brian Balthazor explains: "Audio clips or entire tunes will be distributed as stand-alone applications allowing 'double-click' play."

Gerry Kearby envisions, "You'll be able to go places and get the song recommendations of lots of people, and then you'll be able to go to these big servers and make your own compilations. It will be a much more involving musical experience."

Online ordering, in which listeners sample music but receive the product through the mail, will eventually give way to still newer sales methods. Computers are just

## Todd Rundgren's Waking Dreams

you always had the capability of changing it.

I'm hoping for a day when the fixation on the term "interactivity" starts to slack off, and everyone presumes a level of interactivity in all things and it gets down more to identifying your options, your navigational model. It's not so much interactive as immersive. Immersive is a model for interaction in that you're still yourself in this new place and you still use the same ways of scanning things that you would in the real world. Rather than a Netscape model, in which everything is a page and you flip to the next page and the next page.

**Realtime Internet audio technologies like SoundStream could end the record-company-selling-a-piece-of-plastic business model. But how important is ownership, really? I've heard that many people only play a given CD a few times, so it might make more sense for them to rent it.**

Our ideal alternative method — although this only works for artists who have developed some attractive element that causes people to have faith in them in the first place — is replacing the record company with the listeners as the patron of the development of the work. In other words, record companies advance you money for you to produce the product. They expect to take from the listeners later. If we're going to eliminate the discs, why don't we just eliminate all



Clicking on the SoundStream controller lets you start, stop, pause, and change volume and playback location of an audio clip.

off by suddenly prosecuting individuals.

But whether you listen to it once or a hundred times, it's impossible to tell what the value of it is once you eliminate the hard objective costs of making and distributing it — seven or eight bucks. The rest of the cost is the value of the music. Whether it's shitty or whether it's good, the rest of the music is worth four bucks. There's never been a way to actually say what the monetary worth of the listening experience is, only a way to say how much it costs

*Continued on page 42* ►

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READER SERVICE NO. 124

# Realtime Internet Audio

starting to ship with recordable CD drives in them. As these become more affordable and more common, people could sample songs from an Internet distributor, create playlists of their favorites, and then download the full selections to disc, paying electronically by credit card. Even now, it's possible to order complete interactive music programming from a catalogue of nearly 10,000 titles through Digital Music Express systems. Although this system isn't Web-based, it could indicate some of the choices we may soon have from the Net.

"It took at least five years for the CD to make serious inroads," says Michael Goldberg. "And it took all six of the major companies that account for 90% of sales worldwide to push for it. It took a lot of cooperation to get to the point where you could get an inexpensive player and everything was being released on CD. I think this is going to be a similar process. The number of people who have computers is small compared to the number of people who love music. And most people don't listen to music at their computer."

"There have been companies that sell music online, with their own proprietary system that lets you buy music and download it onto your PC," says Mika Salmi. "But big deal, it's on your PC. At this stage, you're not going to sit in front of your computer and listen to music. One of the beauties of music is that it's portable — you can take it on a walk, in the car, wherever."

One recent product that makes music from the Net portable is the Listen Up Player from Audio Highway. This hand-held, battery-operated device allows listeners to select, retrieve, store, and play back audio from supporting Internet sites. Up to an hour's worth of audio can be played either through the built-in speaker, headphones, or your car or other common stereo system (using an internal transmitter).

### Increasing Demand & Accessibility

As the Web and its audio-based technologies become more popular and accessible, it will be increasingly supported and utilized by mainstream artists and their record labels. By offering not only recorded songs and live chats but also online concerts and radio programming from global cyberstations, the Web will enter the mainstream. One thing that promises to help this along are "set-top" boxes, which

promise compact, affordable, and easy-to-use access to the Internet. In so doing, they will most likely bridge the gap between work and entertainment, computer and television, Net-time and prime time.

"What's really going to open the window is something called WebTV," says Brian Balthazar. "It looks like a cable box that plugs right into the TV and lets you cruise the Web. It's the cheapest way to get on the Net and allows immediate Web cruising. It has an infrared keyboard, a hand-held remote, a 'smart card' for your Visa card (the ultimate peripheral!), and an add-on card slot. There's an MPEG decompressor inside, and you can record from the audio jacks into your stereo. There you have the ideal scenario — you're using the existing audio equipment structure. While there's been this whole separation between the computer room and the entertainment room, this now puts it back into the entertainment camp. I think within the next two to three years, it will be the *de facto* way of content delivery."

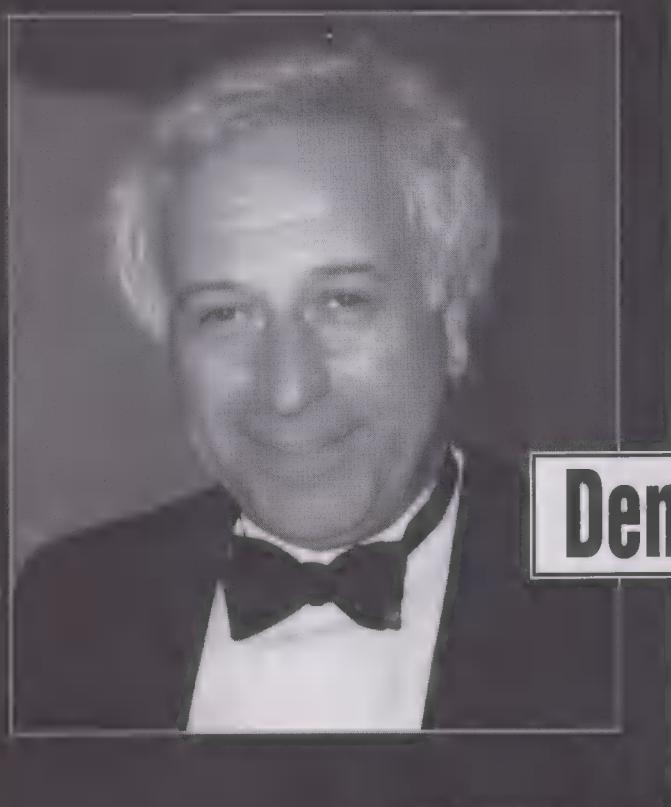
While we can expect to see an increase in bandwidth, whether by cable modem, phone lines, or satellite dishes, it's clear that the demand that might be placed on the Net when it does finally hit prime time will cause users to effectively see less available bandwidth.

"Two years from now, we'll probably be behind where we are now," predicts Steve Church, president of Telos Systems, who specializes in transmitting high-end audio over various types of networks. "What really needs to happen is multicasting, where the Internet itself performs the reproduction of the stream. When you're doing this, you don't need an individual stream from the server back to each listener. At that point, we'll see all sorts of possibilities involving multimedia."

While Jon Luini of MediaCast agrees, he also predicts, "The Net is always going to continue to grow at the rate it needs to. It's always going to have its problems before the next level of growth, but it will continue to grow. It's clear that getting the multicast stuff happening is a solution to the whole Net-getting-clogged-and-dying issue. It's really a question of when and how rather than if."

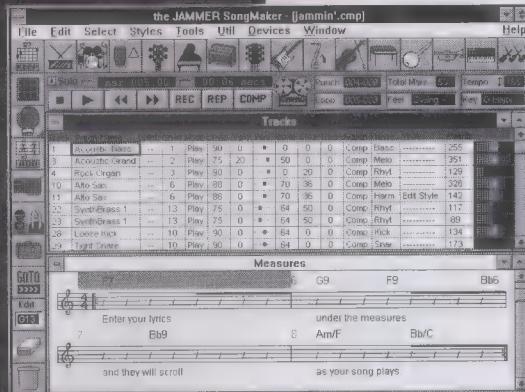
We'll eventually see even more interactive multimedia reach the home. "The virtual world stuff is going to be big," says Ben Dillon. "It'll take maybe three years for it to

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## Realtime Internet Audio

really start cranking up. I think streaming video is really the Holy Grail of what people want to do."

As we enter this era of virtual storefronts, galleries, and malls, our technologically mediated experience will be filled with very real opportunities to hear and see new music, art, and other forms of expression. Is it a utopia? No, but for now the Net is relatively free of commercialized mainstream programming, and it's not adversely controlled by mega-corporations or governmental regulation. To a greater degree than any before, this medium enables people to interactively find and access whatever interests them, including the rare, unusual, and unpredictable. More importantly, it offers a forum to create, present, and discuss whatever we can dream up, limited only by time and talent. "This is a really promising future," states Jim Griffin. "But it's the right time to be thinking education and the wrong time to be thinking profit."

Musically, the streaming technologies discussed in this article mix convenience with quality in new ways, enabling us to do things we couldn't do before, offering a more level playing field as well as an opportunity for people to use the Internet medium in unique and creative ways. Right now, we are at the frontier of this technology — the possibilities are wide open. As we look (and listen) to the Web in new light, we can expect truly extraordinary results, and a revolution that may rival that of the Industrial Age. 

*Joshua Salesin creates music and video for various Internet sites and CD-ROM games from his computer music studio in Santa Cruz, CA. He can be reached at summer@addict.com.*

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## Todd Rundgren

◀ *Continued from page 39*

to bring it to you. And that's going to have to continue to be the measure of how people get compensated.

What would it be like if people could listen to something and say, "I didn't like that. Give me my money back."? Prove you didn't like it! Prove to me you didn't like it so I can give you your money back. What if you just lied? What if you loved it and you want it for free? It gets too complicated trying to attach a worth to the actual listening experience. It has to be based on the transaction, never on the worth. So it doesn't matter how many times I listen to it.

Hopefully, it's good enough to listen to twice. But that's just lowered expectations. It used to be that the market was singles. You'd buy a single and just play it over and over, one song. When I got the first Beatles album, I listened to it every day two or three times when I got home from school. It meant a lot to me from a listening standpoint, but it also had all these social implications. The whole experience of imagining, "I could do this. I could be chased down the street by girls and grow my hair long and all those other associated things that go along with the experience."

I suppose there is something essential to the experience that will disappear — the actual having it in your hands, staring at the album cover, or whatever. Somebody's going to have to come up with a substitute for that part of the experience. The problem is that so much music doesn't justify creating something you can hold in your hands. So much music is meant to be heard and disposed of, that all the tree killing, plastic refining, petroleum transporting, and all the other wasteful parts of the process should be made to disappear as soon as we have a mechanism to deliver it in another way. 

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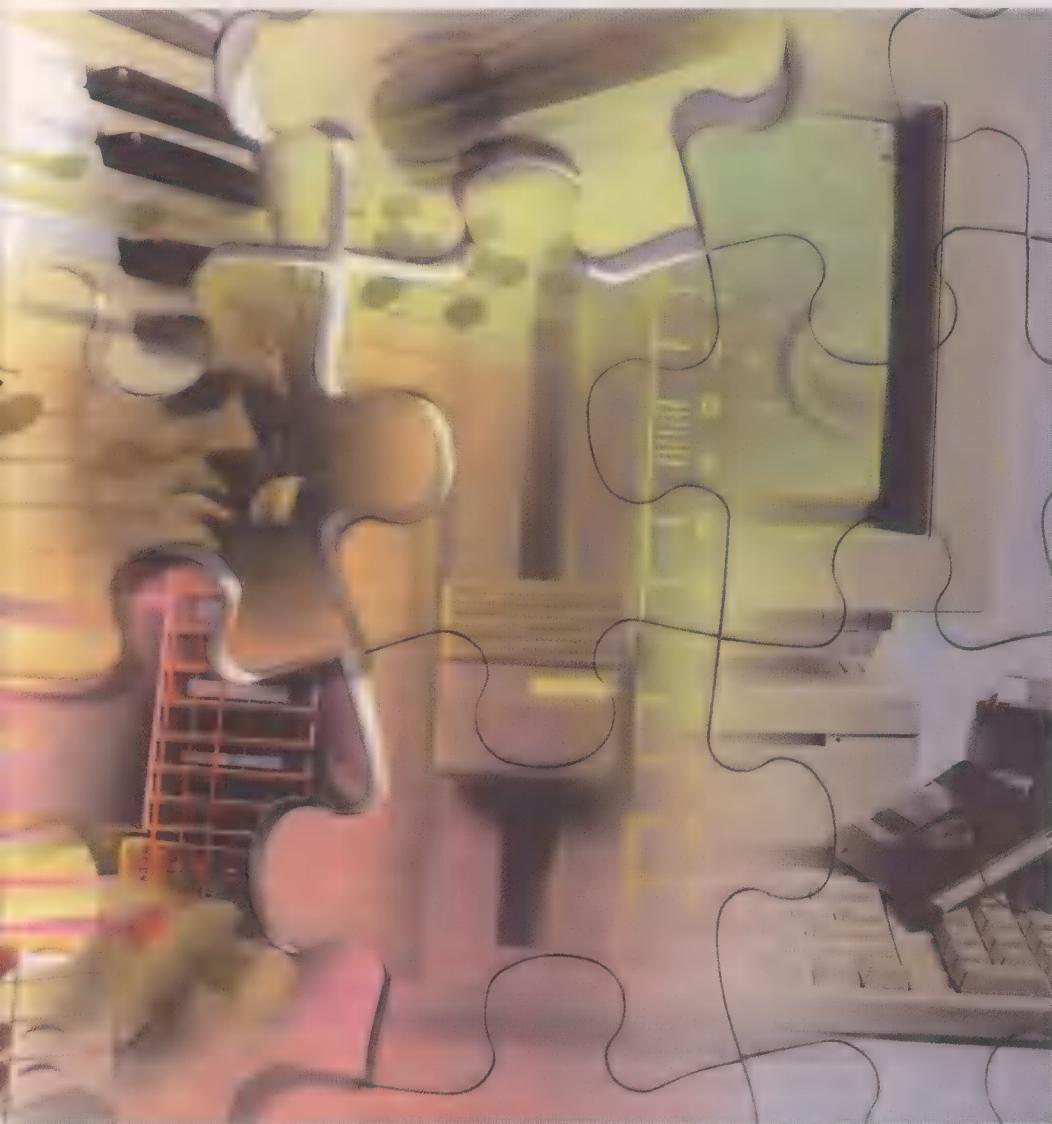
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# FROM DESKTOP TO DISC, PART 3: MIXING

BY DAVE O'NEAL

Welcome to Part 3 of "From Desktop to Disc," or, "How I made an album at home on a fast-food budget and lived to write about it." In this series, I've detailed the trials and tribulations of putting the much-ballyhooed "affordable home recording gear" to use and making an album, unassumingly titled *Erratica*, in the comfort of my back bedroom.

In Part 1 (Sept/Oct '96), I discussed pre-production techniques and how I set up my studio. Part 2 (Nov/Dec '96) chronicled the joys of sound design, basic composition, and esoteric noise-making. This time, we'll focus all that merriment into concise song-shaped nuggets by mixing the audio for maximum sonic impact. The fourth installment will wrap it all up by describing the process of compiling the tunes and mastering a CD for mass consumption — which, as everyone knows, leads inevitably to fame, fortune, and appearances on smarmy talk shows.

## What I Got

As you may recall, I'm not sitting amidst an eye-popping array of expensive gear. No, I have an outdated Macintosh Quadra 660 AV, an Ensoniq VFX synth and ASR-10 sampler, a Mackie 1202 mixer, a few affordable mics, a Hafler amp, KRK K-Rok speakers, and a 1Gb hard drive. The idea is to be creative and bring my unflinchingly

twisted musical meanderings sputtering to life without a mountain of gear that would cost twice my annual income.

I picked up some software for the computer — Opcode Studio Vision for MIDI and audio sequencing, BIAS Peak for graphic sound design, Tom Erbe's SoundHack (shareware) for sound mutilation, AnTares Infinity for looping, and a few others. Using these tools, I created a number of groovy, aggressive, melancholy, spacey, mechanized, and just plain bizarre audio effects. I hammered these into a few song ideas, working on the sound design and composition simultaneously. Now, I'm finally ready to apply a few theories about how sound works to come up with a CD's worth of mixes that grab you by both ears and give your head a good hard shake.

## Striking a Balance

Every sound in a song has a purpose, or at least it ought to. The goal of mixing is to make every sound properly audible in the context of the song as a whole. Pretty simple idea, huh? Unfortunately, if left to themselves, sounds can congeal into a thick aural sludge that tends to approach white noise as the compositional complexity increases. I'm looking for ways to separate and differentiate individual sounds so they're distinct, yet meld harmoniously with their partners in sonic mayhem.

It's just a matter of balancing the volume levels of various tracks, right? Well, whenever I try the volume-only approach, I start with the faders at about two-thirds, then raise the volume of whatever is quietest. Then it covers something else, so I raise its volume. Before long, all faders are

If left to themselves, sounds can congeal into a thick aural sludge.

pegged at the top of the board and the mix sounds as bad as when I started. So let's forget about levels for a minute and try a different approach.

First, each sound has its own frequency spectrum (that is, it's made up of a unique collection of frequencies at various volumes). The ear has a nice way of masking out quieter sounds so you only hear the loudest sound in a given frequency range. This is convenient for things like picking out one voice in a crowd, but it sure made a mess of my mix when I tried to put a slap bass up against a really bright kick drum in a tune I'm calling "Entropy and Inertia."

The attack that made the kick drum so clearly audible was pretty much in the same frequency range that made my beloved slap bass speak out. This made the bass indistinguishable from the kick drum. I tend to like bright drums, so it was the bass that had to go. I changed the sound on my ASR-10 to a fingered electric bass, but this was drowned out by the meaty lower mid-frequencies of the kick drum. I dropped the bass sound an octave; that gave it a lot of depth, but the individual notes became mush.

I resolved to keep the depth while establishing the bass line's presence in a frequency range where listeners could appreciate the notes. I doubled the bass

with a plinky piano-ish VFX sound that didn't conflict with the kick drum. That filled out the spectrum a bit. Still, I was missing the warm midrange you'd expect from a bass. So I fed the fingered bass through my tiny battery-powered Marshall MS-2 amp/speaker in gross distortion mode, recording the result into Studio Vision as an audio track. That did it! Since the distorted bass, deep bass, and plinky attack all happen at the same time, the ear perceives a single bass sound, and a rather rich one at that. It fills in the bottom, pierces through on top, and carries its nifty little melody line where everyone can hear it. And it doesn't step on the drums.

I arrived at this solution through equal parts trial, error, and intuition, but sometimes a more schematic approach can be helpful. Figure 1 shows a rough graph of frequency vs. amplitude of the various voices used in a mix. This gives you a bird's eye view of the frequency spectrum and the potential for one element to mask another, helping you sort out what sounds you might add, subtract, or substitute.

In the graph, there's no sign of a snare drum. That's because the snare drum, which contains a wide range of frequencies, would take up half the picture. If its frequency characteristics overlap those of the other sounds, why doesn't it drown them out? Because of its characteristics in the time domain: It decays to silence very quickly.

The meat of the snare drum falls right in the middle of the fuzz bass spectrum, but we hear the same fuzz bass both before the snare drum hits and after the snare drum decays. Because of its persistence, you hear the fuzz bass even though it's briefly obscured. Also, the drum's regular rhythm prompts the brain to expect to hear it at given intervals. The listener subconsciously gives less attention to the snare's spectral character than to its time-domain effect, namely the

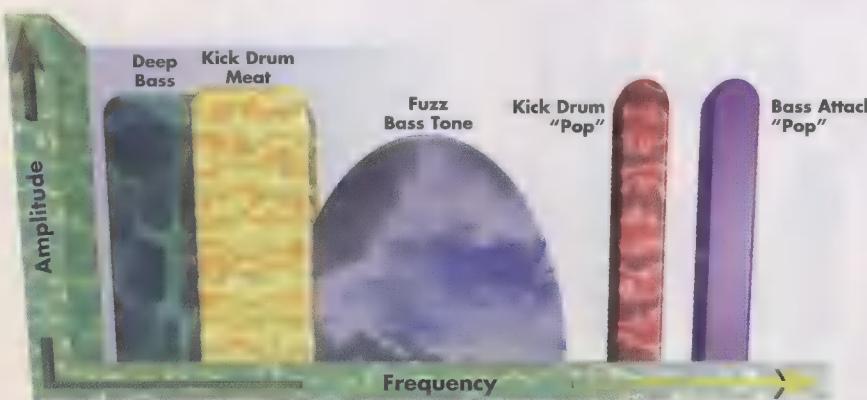


Fig. 1. Sketching out the frequency ranges of the instruments in a mix can help you minimize sonic overlap and make sure all sounds are heard.

groovy beat. This kind of spectrum sharing didn't work for the slap bass and the kick drum's attack because they were both very percussive sounds.

Remember "Hello World," the slam-it-down-your-throat speed funk tune I described in Part 2? I talked briefly about matching the guitar and bass sounds to make them sound like one big instrument rather than two playing in unison. It sounded okay, but after a couple of listens, I decided the effect needed to sound a little tighter.

The ear is very sensitive to transient (very quickly changing) sounds, and capable of recognizing an instrument's characteristic attack — the most transient portion of all — in a matter of milliseconds. Isolating the individual sounds, the guitar has a rather explosive attack (as a result of picking the string and mutilating the output with distortion), then it settles into a stable, wide-frequency sustained portion. The bass sound has a more subtle attack and settles into its sustain phase a little sooner. The trick to pulling them together was to align their attack and sustain portions in a more deliberate fashion. In Studio Vision, I slid the guitar track (audio) ahead of the bass track (MIDI) by five clock ticks. At 129.1 beats per minute and 480 ticks per quarter-note, that comes out to about 5ms. Not a big change, but sufficient to fool the ear into hearing a guitar, and a very deep and stable guitar (because the bass fills in the bottom rather quickly with a smooth synthesized characteristic). Oh, the joy of digital audio.

## Pump Up the Volume

Finally, we're ready to deal with volume levels — but not by pushing all the faders full-on. It's much easier to settle an



*Fig. 2. In the original guitar recording (top window), the average level is fairly low, and there are wide level variations. After the file was processed with Waves' L1 software, the spikes were tamed, allowing Dave to boost the overall level of the file significantly (bottom window). These screenshots were made in BIAS Peak (Mac), though L1 runs on a variety of platforms.*

instrument track into the mix if it has a consistent volume level. This doesn't mean a track's level shouldn't rise and fall, expressing the deepest yearnings of the artist's soul; it just needs a consistent overall volume. MIDI tracks are easy, since you can tweak the velocity of each note. Audio tracks are a different story. They tend to fluctuate for a variety of reasons, and too often these fluctuations are undesirable. I had a friend throw down a couple of acoustic guitar lines in the middle of "Entropy and Inertia" for that time-honored classical-guitar-over-a-funky-rhythm thing. Some moments he played single notes, others full chords, but I wanted this track to be the prominent voice in the mix, so everything needed to be heard.

After we finished recording, I broke the part down, phrase by phrase. I normalized the level of each passage (that is, I processed

the passage, raising its level until its loudest peak was at the highest value allowed by the software). Then I reassembled the melody. It was a valiant effort, but the acoustic guitar still didn't cut through consistently unless I cranked it so loud it overwhelmed the mix. Acoustic guitars have a wide dynamic range (the difference between the loudest and softest notes), which sounds great in a solo setting but creates problems in a multitrack production. I had little choice but to whip out the power tools and squash that dynamic range down to the size of a pea.

Using Peak, I sample-rate converted the file to 22kHz, split it across three floppy disks, and carted all 3.5Mb of data to my office. There, I have access to Waves L1 software. (See Figure 2.) In the last article, I touched on compression, an automatic volume adjustment that amplifies or reduces a signal's level from moment to moment to achieve a relatively consistent overall volume. L1 does limiting, a function quite similar to compression. You tell a limiter just how high to allow a signal's level to be, and every time a signal tries to cross that threshold, the limiter holds it there. Because L1 operates on an audio file, not on a real-time signal, it can look ahead for signal peaks, and prepare itself to do what must be done. ►

# I dropped the processed guitar file back into the computer. The results were most excellent.

L1 squished the acoustic guitar to a tighter dynamic range, making it the same volume at peaks, not-quite-peaks, and right around the middle. Yes, limiting does introduce a bit of distortion at the loudest moments, but that translates to bite. Thus, the volume is consistent, but the peaks sound a little more aggressive.

I dropped the L1-limited acoustic guitar file back into Studio Vision. The results were most excellent. The single-note runs were as audible as the chords, and I was able to give it a volume in the mix that made it prominent but not overpowering.

### Lost in Space

Another way to differentiate sounds in a mix is to position them distinctly in aural space. It may sound obvious, but panning is a simple yet very effective way to make a mix more interesting. Sometimes it's helpful to mix as though you were listening to a live band playing in a big room, with the guitarist close to the front on the left, the drummer way in the back, the keyboardist off to the right (aren't we always?), and so on. (See Figure 3.)

I have a twisted aggro-funk tune called "The Mule" that consists of some gigantic drums, a really omnivorous bass line, and a dinky little Clavinet that provides counterpoint. The juxtaposition of aggressive bass and drums and the tiny Clavinet makes for a good push-pull, but the Clav can get lost in the mix. I panned the Clav way off to the right, put the bass just off center to the left, and splayed the drums across the stereo field. Separating the two harmonic parts, creating a physical distance between them to emphasize the counterpoint, made for a dramatic effect.

Cool, but what if the almighty president of Mudsucker Records, who could fix me for life if he recognized my talent, happens to have a blown right speaker in his car when my tune comes in over the air? Well, sneakily I doubled the Clav with a harpsichord sound that was panned hard left. This changed the feel, making it more like the bulldog plowing through the middle of the sound field with two little schnauzers nipping at the sides. The harpsichord and Clav sound different enough to be perceived as separate instruments playing in unison, and the distance between them nails the effect.

## A little ambience lets composers get away with a lot more than they should.

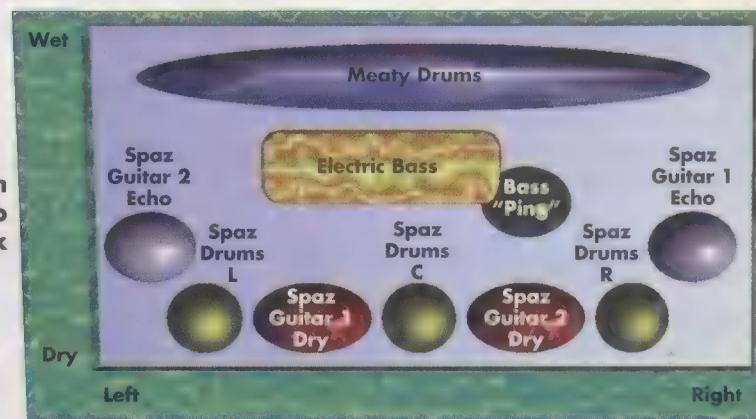
All right. I'll admit it — I'm an ambience junkie. A craving like mine can't be satisfied by something as two-dimensional as stereo panning. I need to create an *environment*, real or imaginary, to hold the mix. The simple solution is to use reverb and digital delays to create a sense of three-dimensional space. When I was trying to get "Hello World," the first tune I put together for this project, up and running, I figured I'd keep the effects simple. The basis of the drum beat was a simple pattern played through a dotted eighth-note stereo echo, which added an intricate shuffle to an otherwise simple groove. I dug it, but a dry guitar sounded out of place beside this wall of drums. So I put the same type of echo on the guitar, giving it a compatible sound field, but flipping the left and right channels on the mixer to fill things out.

There was enough spatial interest in this sound to make me blow off the reverb altogether. With guitars and drums spazzing out all over the place, we needed an instrument to anchor the mix so listeners wouldn't get seasick. As you'll recall, I layered the ASR-10 drums

(spatially spazzing) with drums from the VFX, which were distorted and sporting a tiny bit of room-type reverb. This created a really beefy drum sound, but it wasn't strong enough to do the job at hand. Finally, I put the same kind of room reverb on the bass, so the meaty part of the drums and bass appeared to be playing in the same space. This was enough to contain the mix, creating a stable frame for the spazzed-out guitar and drums. The happy result is a spatially dynamic mix that doesn't confuse the listener with the rash display of flying notes. I like to think this use of space added to the attractive force-it-down-your-throat attitude of the tune.

### Weird Science

In case you forgot, I'll say it again: I'm an unrepentant ambience weenie. Fake-o digital effects just don't sate my jones. In Part 1, after stating my motto, "The studio is where the ears are," I used it as an excuse to blow a few weeks' salary on a portable DAT recorder and some tiny lapel mics. Since then, I've amassed seads of DAT



**Fig. 3.** You can also make instruments stand out of a mix by positioning them left to right (using the pan control) and back to front (using reverb). Here we've sketched out the spatial placement of the instruments in a song to help plan out the mix.

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## FROM DESKTOP TO DISC, PART 3: MIXING

L1 squished the acoustic guitar to a tighter dynamic range, making it the same volume at peaks, not-quite-peaks, and right around the middle. Yes, limiting does introduce a bit of distortion at the loudest moments, but that translates to bite. Thus, the volume is consistent, but the peaks sound a little more aggressive.

I dropped the L1-limited acoustic guitar file back into Studio Vision. The results were most excellent. The single-note runs were as audible as the chords, and I was able to give it a volume in the mix that was prominent but not overpowering.

### Lost in Space

Another way to differentiate a mix is to position them in the aural space. It may sound obvious, but placing instruments in space is a simple yet very effective way to make a mix more interesting. It's helpful to mix as though you're listening to a live band playing it. For example, if you're mixing a guitar player with the guitarist close to the left, the drummer way in the background, and the keyboardist off to the right (aren't you glad you're not a mix engineer and so on. (See Figure 3.)

I have a twisted aggro-funk song called "The Mule" that consists of some guitars, a really omnivorous bass, a dinky little Clavinet that provides the counterpoint. The juxtaposition of aggressive guitars and drums and the tiny Clavinet creates a good push-pull, but the Clavinet is the glue that holds the mix together. I panned the Clavinet to the right, put the bass just off center to the left, and splayed the drums across the stereo field. Separating the two harmonic parts, creating a physical distance between them, and emphasizing the counterpoint, made for a dramatic effect.

Cool, but what if the almighty president of Mudshucker Records, who could fix me for life if he recognized my talent, happens to have a blown right speaker in his car when my tune comes in over the air? Well, sneakily I doubled the Clav with a harpsichord sound that was panned hard left. This changed the feel, making it more like the bulldog plowing through the middle of the sound field with two little schnauzers nipping at the sides. The harpsichord and Clav sound different enough to be perceived as separate instruments playing in unison, and the distance between them nails the effect.

## A little ambience lets composers get away with a lot more than they should.

All right. I'll admit it — I'm an ambience junkie. (Spatially spazzing) with drums from the



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an instrument to anchor the mix so listeners wouldn't get seasick. As you'll recall, I layered the ASR-10 drums

excuse to blow a few weeks' salary on a portable DAT recorder and some tiny lapel mics. Since then, I've amassed scads of DAT



Fig. 3. You can also make instruments stand out of a mix by positioning them left to right (using the pan control) and back to front (using reverb). Here we've sketched out the spatial placement of the instruments in a song to help plan out the mix.

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## FROM DESKTOP TO DISC, PART 3: MIXING

tapes bearing ambiances from a sub-tropical rainforest to a crowded Renaissance fair to countless dive clubs blaring incomprehensible music.

A little outdoor ambience goes a long way toward setting a stage in the listener's mind. In fact, this trick enables composers to get away with a lot more than they should. For instance, for the album I've put together a little spoken-word piece as a segue between "Hello World" and "The Mule." Recording vocals at home is a pain. The computer's fan makes too much noise, the neighbor decides to mow the lawn, the mic is too cheap to capture a good vocal sound, *ad nau-seam*. So I laid down an ambience I recorded sitting out on the porch in the rain, wearing lapel mics on either side of my glasses. The effect is evocative, but not obtrusive, and it buried the worst qualities of the crummy spoken-word tracks I'd made. Then, of course, I had to attract attention to the background by letting out a big sigh while I was sitting on the porch — but it creates a really surreal effect, especially when you're listening through headphones.

I pulled the same trick with the piano track in my locked-in-a-padded-cell-with-Trent-Reznor dirge (yet to be named). All by itself, the gritty piano through the Marshall mini-amp sounded too thin to carry the mix by itself. I layered in a sound that can only be described as a heaving ocean of mercury, courtesy of my ancient Micromoog synth and a digital delay. With that, the puny piano punched through this miasmic audio wall and carried the mix just fine as a solo instrument.

Then a truly weird thought hit me. If you can create a bizarre ambience to set the scene for a more tangible solo instrument, why not set the ambient scene with a few instruments grooving together in a simple room, and play a solo using sounds from one of the outer planets?

This was the idea behind the alien chase scene tune (also unnamed). After throwing down a few Thonk-generated audio swamps (Thonk is "granular synthesis" shareware; see Part 2 for details), I settled into an angry but groovy 7/4 riff set in a simulated small room. The dry rhythm loop on top was created by taking a Kraftwerk rhythm sample and

"boomeranging" it in Peak (mixing it in with a backward version of itself), time-compressing it, dropping it an octave, and looping it in 7/4 rather than the original 4/4. It's a very dry (no reverb) collection of discrete stereo events, focusing the attention to the front of the mix. This dry rhythm loop transitioned to a deep stereo fuzz loop I created by sampling a Metallica riff, running it through the Rotated Sums Looper in AnTares Infinity, and dropping it an octave — a cold artificial ambience. As the noise loop loses its novelty and attention falls back on the groovy riff, I lopped on some horrendously satanic Thonked vocals to scare the bejeezus out of the listener.

Next, the song collapses into a deep reverberant pool like you might find inside a nuclear cooling tower. This ambience started as a regular synth pad and was spectrally mutated with Infinity's Rotated Sums Looper, then processed with Reverb, a shareware reverb program for a very long hall effect. (There's a pointer to Reverb on my Web page.) I got some eerie chanting vocals to descend from above by using varying amounts of both forward and backward Reverb processing. This leads the tune back into the groovy rhythm thing again. However, this time, I slid a rumble track under it (stereo white noise, low-pass filtered at about 40Hz so you feel it more than you hear it). This jacked up the tension a bit.

Guitar crunches convolved with balloon pop echoes from Pinnacles National Monument (see Part 2), trains passing by pitch-shifted way down low — the list of what went into this song is endless. Listening to the groove by itself is boring. Listening to the ambient track alone is interesting but doesn't make a whole lot of sense. Juxtaposing the two is like cruising through an alien landscape in a heavily armored vehicle chasing maniacal beings of another species. Weird enough?

## Back to Earth

Okay, I got the flagrant uses of artificial space out of my system. Let's get back to something more practical, like regular acoustic space. I tried recording a mono vocal line and comparing it with the

same line recorded in stereo with two mics panned hard right and left. With the mics back a foot or two from the vocalist's mouth and separated by about a head's width (emulating ears), I got a much warmer sound. Primarily, this is due to the ambience picked up from the rest of the room, which creates a decent stereo image when the mics are positioned as described.

True, you sacrifice two of your precious digital audio tracks for this effect, but good vocals make a difference. Of course, we can take this idea further. "The Mule" is entirely MIDI-generated at the moment, so I'd like to breathe a little life into it for the final mix. I ran a couple of tests by piping various parts of the music through my small P.A. system (situated in another room) and mixing the speakers in different places. It turned out best when I ran only the bass line through the speakers. Since my synths only have a few outputs and need to play a bunch of sounds simultaneously, I recorded the bass ambience as an audio track in Studio Vision.

## Listen Up

That covers a bunch of nifty things you can do to set up a mix, coerce recalcitrant sounds into working together, and create elaborate sound spaces that may or may not bear any relation to reality. This is all fine and dandy, but the biggest trick to getting a good mix is just listening to what you created. Listen to the tune and take inventory of all the sounds to be sure they're present and singing away. Play your tunes for discriminating friends (not the dorks who say everything is cool; you're looking for feedback here). Ask them what they hear, not whether they like it. They don't have the same familiarity with the tune that you do, and they may not hear parts that you're convinced are perfectly audible.

Even more important, take your mix to a whole slug of different listening environments and run it through the same torture tests. Each unique environment can shed new light on how to make the best sound for all situations. Starting with my K-Rok near-field

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## FROM DESKTOP TO DISC, PART 3: MIXING

monitors, I set up the mix so I could hear all the parts clearly.

Although they enable you to hear the whole mix, near-field monitors are second to headphones for analyzing problem areas. For instance, I had more trouble putting that "Entropy and Inertia" bass line together than I indicated above. Once I got the frequency spectrum filled up properly, the bass line remained muddier than it should have been. I couldn't figure out why. I listened to the mix again on headphones and the problem became obvious: The electric bass sound was leaking into the room reverb I set up for the drums. Through the monitors, whose output mixed inevitably with reverberations bouncing off the bedroom walls,

behold, it sounded deeper there, but not prohibitively so, so all was well.

One of the mysteries of human behavior is that most people do most of their music listening in the car. No, it's not the optimal audio environment, but it's definitely among the most convenient. Car stereos have funky frequency weightings to compensate for the acoustics of the car interior. This is a good test to see just how flat your mix really is — if nothing totally unexpected (typically a low-midrange guitar) suddenly dominates a mix that sounded relatively subdued in the studio, you're in the clear. In addition, the auto environment is rife with background noise. Songs with a wide dynamic range can fall beneath the noise floor during the

Comparing what a home hi-fi does to those tunes with what it does to yours can give you the perspective it takes to achieve pro-quality results. Also, home stereos — especially those with built-in effects or surround sound — have a way of exaggerating audio spatialization. That dreamy echoed guitar solo can turn into a splatter of disjointed frequencies on a loud home stereo, indicating that you should go back to the drawing board and pull back on the effects.

### The Plan

Looking up from the computer for a moment, let's consider how all this mixing stuff fits into the plan. I splattered a lot of ink in Part 2 figuring out how to make really scary sounds. Here in Part 3, I've done the critical listening and figured out how to make these outrageous tones work together. I had to pull off a number of timbral tweaks to get it right.

Some of these tweaks ended up changing the focus of the song at hand, hijacking it into the outer limits. When everything's going well, you get in this iterative loop of sound design, composition, and mixing, performing all functions simultaneously until a polished song bubbles to the surface. This type of song development can take a lot of time. For those of us who didn't marry money, it's far too expensive to be done in a pro studio. The home studio liberates you to express a single unified thought from sound design to composition to mixdown to final production.

As usual, this article contains a number of examples that don't make much sense without hearing them. With that in mind, I've put a few sound files up on my Web page; check it out at <http://www.mindspring.com/~tml/erratica.html>. If you have any questions, feel free to contact me at [erratica@mindspring.com](mailto:erratica@mindspring.com).

See you again next issue, when we take this whole mess and master it onto a real live CD.



**I layered in a sound that can only be described as a heaving ocean of mercury. With that, the puny piano punched through the mix.**

the bass just sounded muddy; but in the near-perfect audio isolation afforded by headphones, I could hear the distinct reverberation of the deep bass. Taking the reverb of the bass entirely sounded a little raw, so I used the headphones to find just the right level of room to integrate the bass with the rest of the mix while maintaining its definition. When I took the headphones off, the mix made my ears feel a whole lot better.

Next, I recorded the mix to DAT, making a couple of versions with various low-frequency characteristics, and took the DAT player everywhere that might offer an opportunity to listen through different speakers. I suspected my home studio of being a little light on the bass, so I played the mix on my near-fields at work. Lo and

quiet parts. This isn't to say you should emulate the hyped-up, piped-in, compressed-to-kingdom-come sound of your local hard rock radio station. It just drops a clue that the quiet parts may need something else to help them pierce through a noisy environment, such as a boost to the high frequencies or less reverb.

Run your mixes through a home stereo and a couple of boom boxes, too. Compared with studio monitors, these systems are geared less for critical listening and more for filling a given space with sound. Just like the car stereo, home systems come with a variety of frequency weightings that can make a mix that isn't flat break apart in seconds. It's a good idea to play your recordings back to back with a few CDs you respect for their production value.

*Aside from spewing volumes of erratic noise out of his home studio, Dave O'Neal plays and records with his band Industrial Soup and writes video game music and software for Electronic Arts.*

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# IN NOISE!

**S**o you've finally got your new hard-disk recording system installed. Or your old system reconfigured, moved, or expanded. You go to work, pump out a flawless cut, and . . .

There's a hum all the way through it that sounds like a group of meditative bees asking, "What went wrong?"

Or there's a continual hiss in the background. (Perhaps your system commenting on your audio engineering skills?)

Or just plain nasty sounds that defy description.

Noise, which can be defined broadly as unwanted sound, may consist of non-periodic sound waves (e.g., hiss, rumble) or periodic waves (e.g., hum, whine). It can manifest as a distorted, grainy, or lifeless sound, or as artifacts such as clicks, pops, chirps, or warbles.

In whatever form, noise is perhaps the most pervasive, aggravating, and puzzling problem in hard-disk recording. It's as if Picasso's brush

KEEP YOUR  
DIGITAL  
RECORDINGS

CLEAN & PURE

By Mike Hurwicz

# STOP THE NOISE!

suddenly leapt out of his hands and began spattering mud on the canvas.

Noise can have many causes. For instance, slow computers can drop bits of audio, creating strange noises. Then there's acoustic noise, sound waves that come from the computer's fan, a creaking floorboard, or passing traffic, and are carried through the air to your microphone. In contrast, electromagnetically induced noise (electromagnetic interference, or EMI) starts not as sound but as electromagnetic waves, which silently assault audio signals as they're traveling down a wire — with unpleasantly audible results. The ugliest of all noise, however, is digital distortion, which may occur during recording, if an error occurs during file backup (especially to an external DAT drive), or during signal processing — even when the goal of the processing is to remove other types of noise!

Even top audio pros have torn their hair out for days chasing a stubborn hum or mysterious click. However, most of the noise monsters that plague hard-disk recording can be tracked to their lairs within minutes or hours. Better yet, it may be possible to avoid them in the first place.

## Getting Up to Speed

Digital sound files are big. When you're recording multiple tracks, or playing several tracks while recording another one, the sheer bulk of material can be too much for your computer's hardware or software. A momentarily overwhelmed computer may drop bits of audio that it should be recording. On playback, the resulting discontinuities usually sound like clicks or pops. This situation is most likely to arise if you're using disk caching. Disk caching is a system that

saves data in RAM and then writes it to disk in large chunks. During the writing process, the computer may be too busy to store incoming audio data. For this reason, it's usually recommended that you shut off disk caching during a recording session.

Many older drives also take time out to do a "thermal recalibration," which adjusts the positioning of the drive's read/write head to compensate for the slight expansion of the drive's platter as it heats up. Though thermal recalibration takes only milliseconds, it can cause noticeable audio dropouts or even lock up your recording software. Thermal recal dropouts are only an annoyance during playback; during recording, they can destroy a great take. Some drive manufacturers, like Quantum, build drives that postpone thermal recalibration until idle periods and will not interrupt read or write operations for thermal recalibration.

You may need a faster hard drive, one that postpones thermal recalibrations, or a computer with a faster CPU or bus. Before you get out your checkbook, though, learn all you can about optimizing the operating system and digital recording software. Under Windows 3.1, for instance, your software may run better in Standard mode than in 386 Enhanced mode. Or vice-versa. You may just need new driver software (which is usually free) for your SCSI card, rather than a new disk.

In addition to manuals and the recording software manufacturer's tech support line, Internet mailing lists and online forums are good places to get clues about what works best. A good Internet mailing list for Mac users is daw-mac. To subscribe to the "digest" version (a good way to start), send a message to daw-mac-request@lists.best.com with the word "subscribe" on a single line in the body of the message. PC users should send a message to

majordomo@lists.mindspring.com with "subscribe pc-daw-digest" in the body of the message. Both of these are general-purpose lists. If you want information about specific products, ask the vendor about a mailing list, or post a query on a general-purpose list. Online services like CompuServe, AOL, and Prodigy have tons of vendor-specific support forums. Also check out their MIDI/Music forums and Craig Anderton's forum on AOL (keyword SSS).

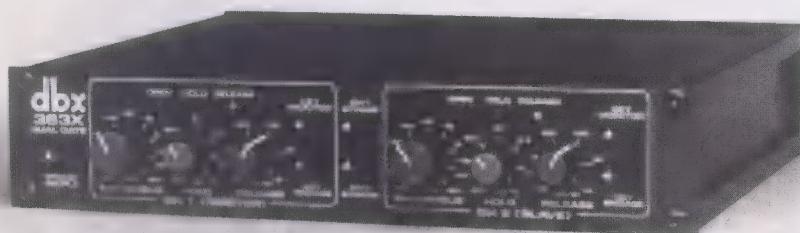
## Acoustic Noise

Once you've been working with computers for a while, your mind begins to filter out familiar sounds like whirring fans and clicking hard drives. But your microphones don't, and your music can come out sounding like it was recorded live on a runway at the local airport! No wonder — some computers have as many as four "propellers" going all the time: the CPU fan, the power supply fan, a fan for the SCSI drive(s), and one for add-in cards.

Microphone placement and using directional mics can help reduce pickup of unwanted sound. And, of course, computer noise won't be a problem if you have an acoustically isolated control booth. That's not the case with most home studios, though. In fact, when the "engineer" and the "artist" are the same person, isolated controls are a downright nuisance.

Before recording a track that you may want to keep, try recording just the mic output with no music performance. Take a look at the residual noise waveform on the screen, or listen to it through headphones. This will tell you immediately whether you've got a background noise problem.

One common solution is to isolate the computer — by putting it in the next room, for instance; even putting it under a table will help a little — and then using special extension cables to get the screen and keyboard into the recording area. Companies manufacturing such cables include 3M, DataDoc, and System Connection (see the manufacturer contact list on page 62 for more information), but most well-stocked computer stores should be able to help you. You're well advised to carefully inspect your system's connectors before visiting the store, or bring detachable parts along with you. Don't rely



A noise gate, such as this dbx 363X, mutes the signal fed through it when the signal's level falls below a preset threshold. This is a quick way to remove hiss between songs or noise entering a microphone between vocal phrases.

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studio. Acoustic noise can also be addressed via a variety of acoustic tiles, baffles, traps, and so on, which alter the reflective/absorptive qualities of walls and ceilings. Acoustic insulation and room design is a whole book in itself. (Try *How to Build a Small Budget Recording Studio from Scratch*, by F. Alton Everest and Mike Shea, or *Building a Recording Studio*, by Jeff Cooper.) Caution: Don't put the computer in a closet or any kind of enclosure without adequate ventilation; components such as the power supply can overheat and fry.

If you're a PC user, you have another option: a very low-noise computer like the Quiet PC from Decibel Instruments. The Quiet PC has just one ultra-quiet low-power fan located in the center of the box. To compensate for the reduced fan power, the power supply has extra heat sinking. Also, the Quiet PC's hard drives are encased in a rubber-like material and have special heat sinks. The Quiet PC will cost you about \$1,000 more than a comparable "noisy" PC. Unfortunately, there's no "quiet Mac" yet.

Another way to eliminate computer fan noise is to record your acoustic tracks in a non-computer environment, such as direct to DAT tape or to a digital multitrack tape deck. Tracks can then be transferred digitally to some computer recording systems with no loss of fidelity. The technology for performing this transfer and the process of syncing up such pre-recorded audio to MIDI overdubs are beyond the scope of this article.

coils in the guitar's pickup act as an antenna, picking up electromagnetic waves created by the AC current. The pickup's coils convert those waves into an electrical current, which the guitar amp turns into hum.

Electromagnetic waves can induce currents in your audio cables, too. Radio frequency (RF) waves from power supplies and monitors can travel through the air for many yards to infect cables. House current produces lower frequency waves (60 cycles per second in the U.S.) that can usually travel only a few inches through the air. But a few inches is more than enough if the house current gets into an audio cable.

Here are half a dozen straightforward precautions you can take against electromagnetic noise:

- Don't run audio or digital signal cables next to power cords or transformers ("wall warts"). Audio cables can pick up hum. Even digital audio signals can be damaged, though this is less likely. Some experts even avoid bunching audio cables together. If you must place an audio cable next to a power cord, make sure it crosses the power cord at an angle rather than running parallel.

- Look out for "unterminated" audio cables that don't connect to anything on one end. They have a particular tendency to act as antennas. If nothing's connected to one end of a cable, unplug it completely.

- Keep your audio cables as short as possible: Short cables pick up less RF energy, and what they do pick up is mostly in the higher frequencies. A two-foot length of

# MAKING CONNECTIONS

When hooking up digital and analog audio devices, you'll encounter a variety of connectors. Here are the main formats:

**U:** This professional digital audio standard is based on the acronyms of the Audio Engineering Society and European Broadcast Union, two groups that define how the signal is transmitted electrically. Although in a single cable, AES/EBU is a standard and is very similar to the S/PDIF (see below). At the physical level, AES uses three-pin XLR connectors.

**d:** An audio signal configuration in which the two hot leads carry audio signals that are out of phase. Balanced

connections are good for reducing noise.

**jack:** A (female) receptacle into which a plug is inserted. See plug.

**mini-phone:** An 1/8" diameter connector found on many portable tape players and computer audio setups, identical to the phone connector but smaller and shorter. See phone.

**phone:** A 1/4" diameter connector, a.k.a. "guitar cord." Phone plugs and jacks come in both mono and stereo versions.

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**TRS:** Tip-ring-sleeve. TRS phone and mini-phone plugs are used for stereo audio connections, with one channel connected to the tip and the other connected to the "ring" (a metal region between the tip and the sleeve). The sleeve connects to ground. TRS connectors are also used for balanced monaural audio connections; in this setup, the tip and ring both carry the signal. See balanced.

**XLR:** Though invented and trademarked by ITT-Cannon, "XLR" is now an industry generic term for round, latching three-pin connectors that are compatible with Cannon's original design. XLR connectors are used for balanced audio, microphones, and AES/EBU digital signals.

# STOP THE NOISE

suddenly leapt out of his hands, spattering mud on the canvas.

Noise can have many causes. For instance, slow computers can produce audio, creating strange noises. The acoustic noise, sound waves travel from the computer's fan, a cereal box, or passing traffic, and a through the air to your microphone. Contrast, electromagnetically induced (electromagnetic interference, or I not as sound but as electromagnetic noise, which silently assault audio signals as they're traveling down a wire) to unpleasantly audible results. The source of all noise, however, is digital noise, which may occur during recording, if an error occurs during file backup (especially to an external DAT drive), or during signal processing — even when the goal of the processing is to remove other types of noise!

Even top audio pros have torn their hair out for days chasing a stubborn hum or mysterious click. However, most of the noise monsters that plague hard-disk recording can be tracked to their lairs within minutes or hours. Better yet, it may be possible to avoid them in the first place.

## Getting Up to Speed

Digital sound files are big. When you're recording multiple tracks, or playing several tracks while recording another one, the sheer bulk of material can be too much for your computer's hardware or software. A momentarily overwhelmed computer may drop bits of audio that it should be recording. On playback, the resulting discontinuities usually sound like clicks or pops. This situation is most likely to arise if you're using disk caching. Disk caching is a system that

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postpone thermal recalibration until idle periods and will not interrupt read or write operations for thermal recalibration.

You may need a faster hard drive, one that postpones thermal recalibrations, or a computer with a faster CPU or bus. Before you get out your checkbook, though, learn all you can about optimizing the operating system and digital recording software. Under Windows 3.1, for instance, your software may run better in Standard mode than in 386 Enhanced mode. Or vice-versa. You may just need new driver software (which is usually free) for your SCSI card, rather than a new disk.

In addition to manuals and the recording software manufacturer's tech support line, Internet mailing lists and online forums are good places to get clues about what works best. A good Internet mailing list for Mac users is daw-mac. To subscribe to the "digest" version (a good way to start), send a message to daw-mac-request@lists.best.com with the word "subscribe" on a single line in the body of the message. PC users should send a message to

phones don't, and your music can come out sounding like it was recorded live on a runway at the local airport! No wonder — some computers have as many as four "propellers" going all the time: the CPU fan, the power supply fan, a fan for the SCSI drive(s), and one for add-in cards.

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The Furman IT-1220 isolation transformer is a new type of power conditioner that provides balanced power, greatly reducing ground-loop hums and radiation from electrical cables into audio circuits.

on a salesperson's psychic powers to figure out what you need.

Once you've got the noise-making parts of the computer in the next room, you can use insulation (such as fiberglass or acoustic isolating foam) in or on the walls to prevent noises from leaking into your studio. Acoustic noise can also be addressed via a variety of acoustic tiles, baffles, traps, and so on, which alter the reflective/absorptive qualities of walls and ceilings. Acoustic insulation and room design is a whole book in itself. (Try *How to Build a Small Budget Recording Studio from Scratch*, by F. Alton Everest and Mike Shea, or *Building a Recording Studio*, by Jeff Cooper.) Caution: Don't put the computer in a closet or any kind of enclosure without adequate ventilation; components such as the power supply can overheat and fry.

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## Electromagnetically Induced Noise

Electric guitarists know that a guitar will hum when held near an AC power cord. The coils in the guitar's pickup act as an antenna, picking up electromagnetic waves created by the AC current. The pickup's coils convert those waves into an electrical current, which the guitar amp turns into hum.

Electromagnetic waves can induce currents in your audio cables, too. Radio frequency (RF) waves from power supplies and monitors can travel through the air for many yards to infect cables. House current produces lower frequency waves (60 cycles per second in the U.S.) that can usually travel only a few inches through the air. But a few inches is more than enough if the house current gets into an audio cable.

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# STOP THE NOISE!

cable may get only noise frequencies that are too high and levels that are too low to cause any problems.

- Avoid fluorescent lighting in your studio, if at all possible. (Fluorescents produce considerable acoustic noise, too.) Dimmer switches are another culprit.

- Try not to put heavy appliances, such as refrigerators and air conditioners, on the same circuit as audio equipment. The heavy current they draw makes them potent sources of noise on the power line. Smaller appliances with motors (blenders, hair dryers) are also offenders.

- Get a line conditioner (not just a surge suppressor).

- Try moving the soundcard to a different slot in the computer. The inside of a computer is full of electromagnetic noise, and the soundcard's wiring may just be in a bad spot.

## Tracing Hums & Whines

Okay, what if you've taken these precautions and you're still getting a hum or a whine? Usually, one cable, power cord, connector, or piece of equipment is responsible, but it can be hard to find out which one, because EMI tends to spread throughout the system. A computer monitor may produce RF interference, for instance, that is picked up by every cable in the system. Similarly, a single bad connector may cause 60-cycle hum in multiple cables and devices.

You may be able to eliminate RF interference just by reorienting the source — turning your computer monitor 90 degrees, for example — and/or moving it farther away from the "antennas." Or perhaps you can shield it from the antennas with a sheet of metal. If reorientation, distance, and shielding don't help, you may need to get the offending piece of equipment adjusted, repaired, or replaced.

Luckily, RF problems are relatively rare. Sixty-cycle hum, on the other hand, is as common as the proverbial cold.

### Hummmmmmmmm

Sixty-cycle hum is usually caused by grounding problems. Grounding is a connection to the earth that provides an electrical "safety drain" for audio cables and equipment.

Ideally, no house current should flow in the chassis of a piece of audio gear. In reality, a small amount often does. Again, ideally, any current flow in a chassis should be harmlessly drained away through the third pin of the power cord to an earth ground such as a metal water pipe.

But if the "drain" (power cord, house wiring, etc.) gets "clogged," even slightly, at any point, electricity can start backing up into your audio equipment and cables, seeking an easier path to ground through the other "drains" (see Figure 1).

What can clog up a ground path? The list is long: a bad connector, improper house wiring, corrosion on the third pin of a power cord or in the wall socket, or a power cord that has no third pin — no drain at all.

Depending on how much current is in the chassis, the results of poor grounding can range from annoying to life-threatening. On the annoying end of the spectrum: If only EMI is being drained to ground, a bad ground will usually just produce a hum or whine. At the life-threatening



Humfrees non-conductive bushings (distributed by Dana B. Goods) help break ground loops by isolating rackmount devices from each other.

extreme: If a piece of equipment shorts out internally and has a bad ground, you could not only hear a nasty hum, you could electrocute yourself touching a "hot" chassis. Your body becomes the drain of last resort for a flooded system.

It's important that every piece of gear have an easy path to ground, so that you don't get a shock. It's also important that they have equally easy paths to ground. Even small differences can cause some electrical "backwash." And backwash means hum, as the audio cables pick up the alternating current's electromagnetic field.

In Figure 1, for instance, if both the mixing board and the computer have easy — and equally easy — paths to ground, you should have a nice, quiet, safe system.

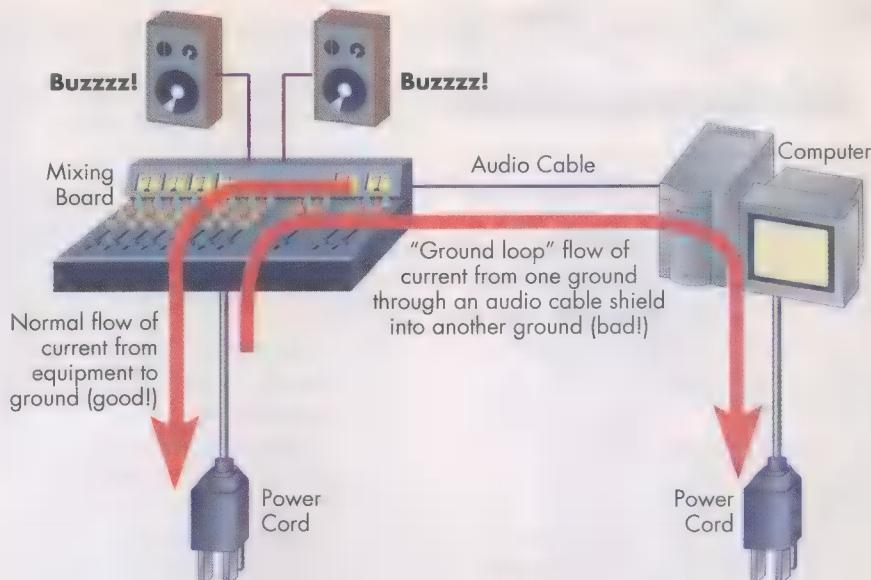


Single-ended noise reduction units, such as the Behringer SNR-202 Denoiser, remove hiss by automatically reducing the treble in a signal during quiet sections.

On the other hand, if corrosion in the mixing board's plug or socket raises the resistance of the ground path, current will start to back up through the audio cable's shielding into the computer, and you may get a hum. The worse the corrosion, the more current will back up, and the more hum you'll get. If the third-pin ground is for some reason "lifted" entirely (if it has a two-pin adapter on it, for instance), you could get a lethal shock if something shorts out inside the mixer.

To start chasing a hum problem, you can test the ground (as well as the "hot" leads) of each socket using an inexpensive device available from an electronics supply store such as Radio Shack. If the ground (or anything else) on a socket is bad, call an electrician.

If the sockets test out okay, maybe you have power cords of vastly different gauges or lengths. James Chandler Jr., a CompuServe MIDIFORUM sysop, mitigates this problem by using a "tree of power" — several outlet strips connected to a single source outlet strip, which plugs



**Fig. 1.** When an electrical signal has several possible paths to ground, it will take the easiest path. A flow of current will appear in the ground connections of the system, resulting in the dreaded 60-cycle hum.

into the wall. Using a single wall socket eliminates any differences in resistance from the socket to the earth ground. The tree structure ensures that all the ground paths are the same length and include the same number of plugs and sockets. (Each

plug and socket adds some resistance, even if they're all in perfect condition.)

Of course, this assumes all your equipment combined draws no more current than can be supplied by one circuit — a fair assumption for most home studios. If

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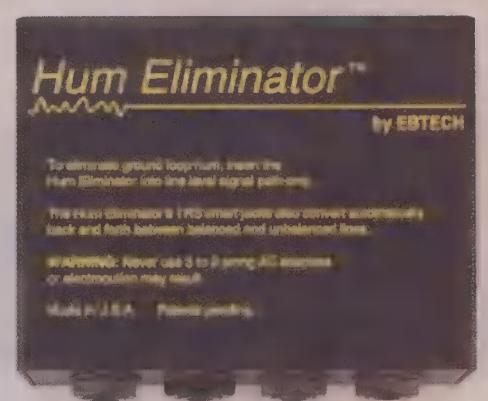
you're concerned about how much current your equipment draws, here's how to figure it out: Look on the back of each device to get its wattage, and then use the formula amps = watts/volts to figure out its amperage. For instance, a 25-watt device running on a standard 120V circuit will draw 25/120, or about 0.21 ampere. Add up the total amperage of your system, and compare this figure with the ampere rating of the circuit breaker in your breaker box.

As another hum-busting precaution, Bill Thompson, the proprietor of Audio Enterprise, a recording studio in Pottstown, PA, makes up audio cables that are not grounded at the input end, making it impossible for current to flow out of the shield at that end. Virtually no current can back up into a shield that's "plugged" like that, so the audio signals should be safe from hum. (Having a shield that is not grounded on one end is different from having a cable on which the signal-carrying central conductor is ungrounded on

one end. An ungrounded cable may be extremely prone to EMI; a cable that's ungrounded on one end should not be particularly prone to EMI.) To create such a cable, simply wire up a plug so the cable's shield doesn't connect to the sleeve of the plug at one end.

When putting together a system, Thompson suggests a three-step testing process:

- First, listen to your output device (headphones or amp and speakers) with nothing hooked up to the inputs. That establishes a baseline for listening for noise.
- Next, hook up your equipment one piece at a time. Use the same audio cable with each piece of equipment, if you can. If you get hum with a particular device, make sure its output is turned up all the way, so that you're not amplifying the hum by turning this device's inputs up too high at the mixer (see the section on gain-staging, on page 62). You might also try isolating its chassis from other devices by removing it from



The Ebtech Hum Eliminator uses audio isolation transformers to break ground loops. The stereo model is shown.

an equipment rack: The metal-to-metal connections within a rack can allow ground loops to occur. If the hum is coming from an older piece of gear, a trip to the repair shop might be in order. If it's new but inexpensive, there may not be much you can do.

Thompson, who is handy with a soldering gun, has also eliminated hum by substituting a three-pin for a two-pin power cord, but this is not something you should try unless (a) you've taken a course in electrical engineering and (b) you don't

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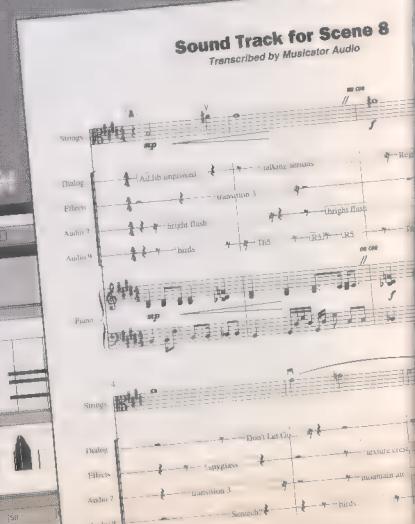
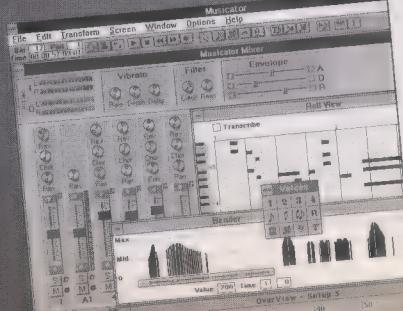
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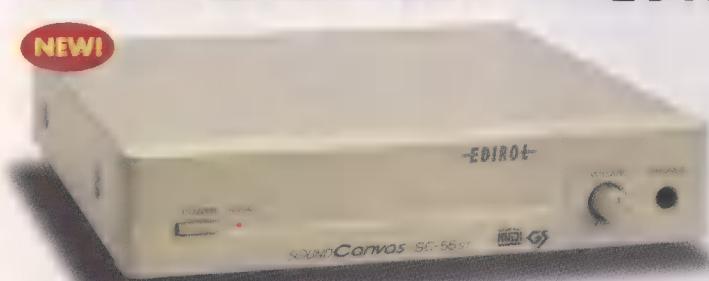


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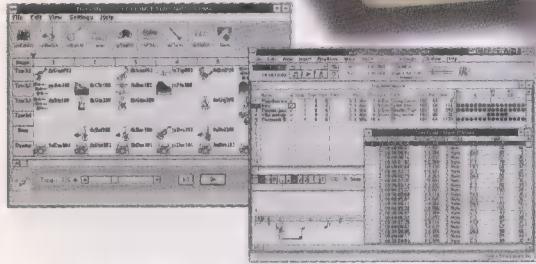


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# STOP THE NOISE!

mind voiding the warranty on your gear. You might also consider buying an audio isolation transformer, such as the Furman Iso-Patch or the Ebtech Hum Eliminator, which break ground loops at the source.

Finally, start reassembling your complete audio system one component at a time. If you get a hum, look at the most recent piece of equipment you installed, its power cord, audio cables, and connectors. If one particular analog audio cable is causing problems, you may be able to improve its performance by using a product like DeoxIT, from Caig Laboratories, to clean the connectors.

## Gain-Staging

Would you record a vocalist who was standing across the room from the microphone? Only if you're doing a concert recording in a hall with fine acoustics. Otherwise, the mic will pick up far too much room noise. When the vocalist is within inches of the mic, the ratio of voice to room will be much higher. When you set the mic to the desired vocal level at the mixer, the noise level will be correspondingly reduced.

The same principle can be applied throughout your studio. The audio source should be set up to produce its maximum volume. If it's a synthesizer, crank the volume knob all the way up. Then use

your mixer's *input trim pots* to reduce the level of the signal in that mixer channel. When you turn down the input trim, any noise that has been added by the audio cables will be reduced as well. Doing these adjustments systematically to all of the audio in your studio is called *gain-staging*.

If the input trim is set too high, the incoming audio will distort. (Some mixers provide a little red LED called a *clipping indicator* on each channel so that you can see at a glance where the crackling sound is coming from. If you don't have clipping indicators, check to see whether your mixer's output metering can be switched to monitor one input channel or bus at a time. Again, this will help isolate the source of the distortion.) Conversely, if the input trim is too low, the electronics within the mixer channel won't be working efficiently, which will add noise to the mix. To set the input trims properly, you need to turn each one up and play the loudest audio that will be handled by that channel; when you encounter clipping, turn the trim down just far enough to get the clipping to disappear, plus a little safety margin.

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## Noise Prevention & Removal

You cannot completely prevent audio systems from generating and picking up noise. A certain amount of noise, particularly hiss, is inherent in audio equipment. But here are six more things you can do to minimize or remove noise:

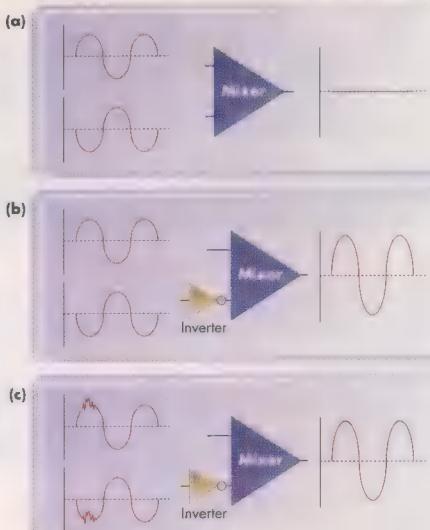
• First, avoid cheap equipment. You can do Windows-based hard disk recording with a Sound Blaster, for instance, but you'll get a lot less noise with a CardD Plus from Digital Audio Labs. One sign of really good audio gear is balanced instead of unbalanced jacks: AES/EBU instead of S/PDIF for digital signals, and XLR instead of phone plugs for analog signals. (Actually, phone jacks are sometimes set up in a balanced configuration, but XLR connectors are almost always balanced. See "Making Connections" on page 57 for more specifics.)

Balanced interfaces and cables use two conductors set up to carry audio signals that are identical but of opposite polarity. That is, if one wire is carrying a signal of 0.57 volts

at a given moment, the other will be carrying a signal of -0.57 volts at that same moment. This is commonly referred to as being "out of phase," though in fact phase and polarity are not quite the same thing. At the receiving end, the negative signal is inverted and added to the positive one, producing a signal whose amplitude is twice what it was on the cable. Since any noise induced into one conductor will also be induced equally into the other, when the polarity is reversed at the receiving end, a phenomenon called "common mode cancellation" occurs: The noise voltages cancel each other out (see Figure 2). Mathematically, the balanced cable method can be represented as:

$$(\text{Signal} + \text{Noise}) - (\text{Signal} + \text{Noise}) = 2 \times (\text{Signal})$$

• Second — and this will cost upwards of a thousand dollars, but it's worth mentioning while we're on the subject of balanced lines — consider installing balanced power. Balanced power reduces noise using the same basic technique as balanced audio cables,



**Fig. 2.** Signals with opposite polarity cancel when summed together (a). In a balanced audio system, two "hot" connectors carry identical audio signals — but the polarity of one signal is reversed as it is being transmitted. At the receiving end, the polarity is flipped again, and the two signals are added (b). Any interference that was introduced to the signal as it traveled down the cable is now "out of phase," and will be canceled out, leaving only the desired audio signal (c).

namely, common mode cancellation. Here's how: Standard power outlets deliver unbalanced power, with 120V on the "hot"

wire and zero volts on the neutral wire. A balanced power isolation transformer splits the voltage, so that the voltage on the two wires is equal but opposite, and the difference is 120V. When one wire has +60V on it, the other has -60V. (Which wire has which voltage changes as the current alternates.) Any noise on the line gets split in the same way. If the current or noise finds its way into the ground system, or induces current in audio cables, the two equal but opposite voltages immediately cancel each other out. So ground currents don't flow, and noises disappear.

Balanced power can be installed either at the power distribution panel of the building or using gear like the ET-R series from Equi-Tech or the IT-1220 from Furman Sound.

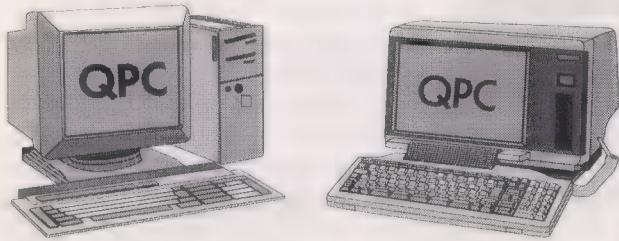
• Third, mute all channels not carrying audio. "If we judiciously use mute buttons or automation to kill unused tracks until they come in, we can get virtually silent performance over the whole song," says Chandler. If you're adding MIDI tracks to your recording, adds Chandler, don't rely on MIDI volume control messages to mute a

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## STOP THE NOISE!

channel. MIDI instruments often hiss the same amount regardless of MIDI volume control messages — and even if they don't, the cable between the synthesizer and the mixer will still be adding its quota of noise to the system. Use mute buttons on your mixing console, or automation in your hard disk recording software, to mute the audio channels of unused MIDI instruments.

• Fourth, use a downward expander to reduce noise during silent portions of a track. When the incoming audio signal drops below the configured threshold level, the expander reduces the output. So when a singer momentarily stops singing, for instance, the expander reduces background hiss. A noise gate is a downward expander that reduces the output to an inaudible level, so there is virtually no noise except when the musical signal is also present — at which time the noise will usually be masked by the music, so it won't cause a problem. Expanders and noise gates commonly come as part of a combined unit, such as the com-

pressors, dynamics processor, and voice processors described below.

• Fifth, you can use noise removal software such as Digidesign's DINR (Digidesign Intelligent Noise Reduction) for the Mac or Sonic Foundry's Sound Forge for Windows (see the "Turbo Tips" on page 67 for more on Sound Forge's noise reduction plug-in). To use these products, you first take a sample of a track at a point where there is no recorded material — just before the music begins, for instance. Any sound on the track at that point is pure noise. Once it has that sample, the software goes through the entire track and digitally removes that noise pattern.

"I have a Wurlitzer [organ] that hums like crazy," says engineer/producer Tim McHugh of Deer Harbor, WA., who has a project studio based on Digidesign's Pro Tools. "I've sampled that hum and stored the sample in a file. Every time I record the Wurlitzer, I use that file to eliminate the noise."

However, warns McHugh, you have to use DINR judiciously, or it will introduce other artifacts such as warbles and chirps.

"It seems to work best to process the material three or four times, by little amounts," he says.

DINR is a Digidesign plug-in and requires either Digidesign's Sound Designer II (SDII) or Pro Tools III TDM. The Sound Forge noise removal utility is also sold as a plug-in, and is not included in the basic Sound Forge package. (For more on how plug-ins work, see "Digital Audio Plug-Ins" in the Nov/Dec '96 M&C.) There are more sophisticated noise removal products, such as Sonic Solutions' NoNoise or Cedar from Cedar Systems, but they have five-digit price tags, compared to about \$1,000 for DINR. The least expensive noise reduction program is probably DART (Digital Audio Restoration Technology) from Tracer Technologies. This stand-alone Windows app starts at just \$99; DART Pro, which includes hum, hiss, and click removal, is \$399.

Finally, you can use hardware or software equalization (EQ) to reduce the level of an offending frequency. For example, if you have a hum or whine at a particular frequency, use the EQ on your mixing

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board or hard-disk recording software to attenuate that frequency. This will obviously affect whatever musical material is in the same frequency spectrum, so the best EQ settings will be those that affect the narrowest possible band of frequencies. Ideally, you'll catch the whine or hum while you're setting up or doing a test recording, so the noise will never get on your final recording. You may be able to determine the frequency and the amount of attenuation required by a little experimentation.

## Digital Clipping

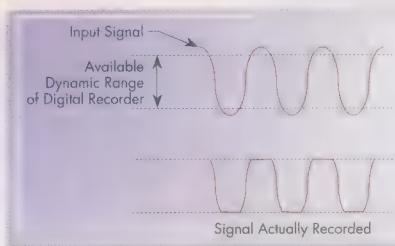
So far, all the noises we've covered are analog audio phenomena, and most of the solutions we've described would work equally well if your recording medium is an analog tape deck. But digital processes can produce horrible noise as well. One of the worst is digital clipping.

Clipping occurs when the input signal gets louder than the maximum that the system can record. The result is that the peaks of the input signal are cut off, turning rolling hills into mesas (see Figure 3). Analog recorders can also clip, and it sounds bad. With a digital recorder, however, clipping sounds indescribably obnoxious.

The most natural way to prevent digital clipping is simply to turn the input signal down until it no longer produces clipping. But in certain situations, such as a live band recording, this may not be practical. If your source material has a wide dynamic range, turning it down also has the effect of reducing the low-level signals to an undesirable level.

To prevent clipping while preserving a hotter overall signal level, you can run the signal through a compressor before it hits the recorder. A compressor reduces the signal's level when the level rises above a certain threshold. Typically, you set the threshold level so that only the loudest sounds are reduced. You also set a compression ratio. For instance, you could reduce all sounds above -10dBu by a ratio of 3:1.

Compression does alter the sound of the material. For instance, rock bands often put heavy compression on drums to squash and tighten up the sound. If you're going for a natural sound, however, you'll want to keep



**Fig. 3.** Clipping occurs when the input signal (top) has a level that exceeds the maximum dynamic range of the system. The outer edges of the sound wave are "clipped" off (bottom), which drastically changes the harmonic content of the sound. Momentary clipping usually sounds like a pop or click; when a whole area of the wave clips, your music will be inundated by thick, grinding, static-like noise. The solution: Turn down the input until the clipping goes away.

the threshold as high as possible (thus, bringing compression into play as seldom as possible) and the compression ratio as low as possible (thus minimizing the effect of the compression when it does come into play). You determine the required threshold and ratio by experimentation while repeatedly recording your loudest segment of material. For instance, slowly bring the threshold up until you get clipping. Then reduce it just enough to eliminate the clipping. Now slowly reduce the ratio until you get clipping. Then bring it up just enough to eliminate clipping.

If the compression ratio is infinite, then nothing louder than the threshold will get through the compressor. In that case, the compressor becomes a *limiter*. Almost all compressors can also function as limiters. Many units, such as the Alesis 3630, combine compressor/limiter/gate functions. Others, like the dbx model 266 or the Rane DC-24, are compressor/expander/limiter/gates. The Symetrix 528E voice processor provides compression, expansion, EQ (which you can use for pre-emphasis and/or minimizing hums, whines, or rumbles), as well as de-essing, which reduces the amount of sibilance in vocal material. Sibilance is a hissing or whistling sound often associated with an "s," "ch," or "sh" sound. Often considered undesirable in vocal material, sibilance can be reduced by cutting down particular frequencies. That's what a de-esser does. De-essing can also be accomplished via software, such as the DINR plug-in.

## Quantization Noise

Sound is an analog phenomenon: The air pressure waves that constitute

sound rise and fall smoothly rather than in discrete jumps. Or, to be more accurate, they rise and fall in millions of atom-sized jumps, giving the illusion of smoothness to our ears and to all commonly available measuring devices. A 16-bit analog-to-digital converter (ADC), however, has just 65,536 possible levels to represent all those millions of real-world levels. Clearly, a lot of fine-grained information is lost when sound is quantized or converted into digital words containing a limited number of bits. Instead of nice, smoothly rounded sound waves, you get the audio equivalent of the "jaggies" that are sometimes visible in a digitized picture.

The audio equivalent of jaggies is called *quantization noise*. And just as visual jaggies show up most clearly on fine lines, quantization noise is most apparent with low-level signals. It's also present in louder digital audio, but the noise is completely masked by the music.

Digital audio engineers use a process called "dithering" to minimize quantization noise. Strange as it may seem, dithering involves adding a bit of controlled noise to the audio signal. All good analog-to-digital converters perform dithering on incoming audio, so you shouldn't normally need to worry about it. However, if you perform DSP-type edits on your audio, such as gain changes, mixing, or EQ, you may need to "re-dither." Your DSP software will probably make some provision for re-dithering.

For more on dither, check out the Web site of Digital Domain, a mastering house in Orlando, FL (<http://www.digido.com>).

## Noise will be Noise

Noise is a beast that can never be entirely tamed, one that often comes snarling out of its cage when you least expect it. Defend yourself with knowledge, perseverance, and careful listening. The results — music that shines through clean and crisp — are worth it.

*Mike Hurwitz is a freelance writer who specializes in PC networking, and he's also a singer/songwriter with a home studio.*

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# Sonic Foundry Sound Forge Noise Reduction Plug-In

Realizing that my odds of achieving rock stardom were much greater than those of winning the lottery, I decided to resurrect the tapes of my first band. We were a pretty good band, so why not try to protect these great pieces of music history for generations to come? Of course, being on a budget at the time meant we used those "three for 99¢" cassette tapes, so "preserving" these recordings to DAT might take some doing. When I popped the first cassette into the deck, pressing Play resulted in a loud wash of white noise with a faint semblance of BTO's "Takin' Care of Business" droning in the background. Oh no! Could I ever salvage what sat before me? Oh, the horror. . . .

Never fear, Sonic Foundry's Noise Reduction is here. This noise reduction software package is a plug-in for Sound Forge, the Windows-based sound editing software. [Ed. Note: We reviewed Sound Forge 3.0 in our Fall '95 issue.] Sound Forge allows you to manipulate audio using a palette of over 50 effects and processes while supporting 30-plus file formats and audio compression schemes.

The Sound Forge Noise Reduction plug-in is extremely effective at removing broadband noise such as tape hiss, hum, and steady background noise from recordings. Unlike a normal filter, it can do this without removing part of the source material. This magic is accomplished by separating the audio into its distinctive frequency components and using a "noiseprint" to distinguish between unwanted noise and the desired signal.

In addition, the plug-in contains a handy click removal algorithm. (I recall many times when I knowingly used a bad cable and introduced an occasional click or pop into my recording. . . .) Sampling or re-mastering audio off of old records? The plug-in also includes a vinyl restoration algorithm that can clean up surface noise, scratches, and other nasties that often occur while playing those old 45s.

There are no hard and fast rules to using noise reduction software, so these tips are a general guideline to help polish your skills. Each noiseprint is unique and relates differently to various source material. A variety of parameters are available for setting the correct amount of noise reduction, including noise reduction amount (in decibels, or dB), attack and release speeds, and high-shelf filtering. Sonic Foundry also conveniently built in a preview feature that allows you to hear the results on a portion of

**by Brian Hamilton**



## Sound Forge TURBO TIPS

a file before actually applying the noise reduction.

### Let the Games Begin

Whether you're making a new recording or transferring a noisy old one to your computer for processing, you should start with a clean audio path. You know what they say — "Garbage in, garbage out." Obvious measures such as removing studio ground loops, replacing bad cables, and turning off the air conditioning (for acoustic recordings) should be carried out. [Ed. Note: See "Stop the Noise!" on page 55 for more on reducing noise at the source.] Keep in mind that inexpensive soundcards can introduce some noise while recording due to their low-quality analog-to-digital converters. If you're mastering to a CD or DAT, investing in a quality audio card will help yield professional results.

### Sample Rates & Bit Depths

For the tape transfer, I recorded the file at standard CD quality audio — 44.1kHz sample rate and 16-bit bit depth. Why would I do this if my source tape is anything but high fidelity? Although it takes more disk space, the 44.1kHz rate will give me a better representation of what is on the tape than a lower rate will. It does this by taking a high-resolution snapshot of the audio. For example, would I be able to grasp the storyline of a TV show better if I looked up from my newspaper once a minute and watched for the next 30 seconds, or if I just put the paper down altogether and watched the darn thing? Catch my drift? It's better to record at the higher rate. You can always resample to a lower rate later in Sound Forge. Resampling from a low rate to a higher one does not improve fidelity.

Second, 8-bit audio is very noisy no matter what playback system is being used. Noise reduction cannot eliminate the noise inherent in all 8-bit files. This bit depth is used primarily by game developers to save CD-ROM/disk space for the audio files. If disk space is not an issue, 16-bit will yield the best results.

### Grab the Noise

It's essential to take a noiseprint before any audio processing begins, with one exception: Removing any DC offset in the file will help the noise reduction process and should be done first. (DC offset occurs



**Fig. 1.** To start the noise reduction process, we have selected a portion of the sound file before the music begins; this section contains only noise. Next, we'll take a "fingerprint" of the noise so the software can recognize it and subtract it from the file, leaving just the original music.

when a constant voltage is added to a sound file, shifting its baseline away from zero volts. A waveform that isn't centered around the horizontal line in Sound Forge's data window probably has a DC offset. Glitches can occur when an offset sound file is processed or combined with other files. Sound Forge's Process menu contains a DC Offset command that can correct this voltage shift.)

Don't normalize or EQ the file yet — this will increase the noise floor, which means that additional noise reduction will be needed just to get back to the original level. That can cause *artifacts* (more on that later). To minimize loss of source material, select a portion of the noise that you want to eliminate in an area of the file where only noise is present (see Figure 1). This region can be as small as 10ms (milliseconds) of the file.

After selecting the noise-only region, choose "Noise Reduction" from the Sound Forge Tools menu. A good starting point is to use the default preset, which will reduce the noise by 20dB. Press the Get button and *voilà!* The noiseprint is generated (see Figure 2). Little squares called "envelope points" are generated about 6dB above the noiseprint, which is a good setting for differentiating the noise from the source signal. The noise reduction algorithm uses the envelope points to determine what parts of the signal are noise. Frequencies in the recording with amplitudes (volumes) below the corresponding envelope point's amplitude are likely to be noise, and are therefore attenuated (reduced in volume). Audio above the envelope points is left untouched.

The envelope points can all be raised or lowered by using the Envelope Amplitude control. If the points are raised too high, it's possible that part of the source

material could be removed. If they are set too low, some of the noise may not get removed. To hear the results, press the Preview button. Additional noise reduction can be accomplished by increasing the decibel (dB) range to a higher number.

The newest release of the Noise Reduction plug-in (version 4.0A) has an option for monitoring the noise being removed without the source material. You can keep tweaking parameters until you hear source material. Contact Sonic Foundry for upgrade information. (The address is at the end of this article.)

### Arty Facts

Hey, what's that whooshing sound? If too much noise reduction was applied to the material, you may hear flange-like artifacts (not to be confused with "arty facts" — statistics on Van Gogh or Picasso). This means the "clean" and the "noisy" signal are so similar in frequency and amplitude that some of the source material is being affected. In the case of my band tape, I needed to apply 40dB of noise reduction, and doing so resulted in these artifacts. What to do? To achieve the same end result, I did two consecutive noise reduction passes at 20dB each. This gave me a total of 40dB of reduction without the unwanted artifacts. Playing with the attack and release speeds can also help in reducing artifacts.

### Attack & Release

The Attack Speed parameter determines how fast the noise reduction algorithm reacts to an audio signal. Very low values often remove fast transients (such as the pick sound in a guitar track) from a sound, while higher values can create audible artifacts when the noise level is high. This occurs because the noise reduction amount is changing too fast. When you're using a large FFT size (resolution) to analyze the file, the attack speed should be set higher.

The release speed sets how fast the amount of noise reduction tapers off. Higher values can trim off the ends of sounds that decay slowly toward silence. This can be useful for "fixing" audio files that have been recorded with a noisy reverb tail on the end.

### High-End Boost

The Sonic Foundry Noise Reduction plug-in also includes a definable high-shelf

filter. This is extremely useful for maintaining high-frequency (HF) content of the source material after the noise reduction is applied. Gone are the days of muddy noise reduction — now you don't have to choose between hiss and sparkle. Frequencies above the designated setting in the High-Shelf box will be cut or boosted by the amount set in the Gain box. In reality, one shouldn't need to boost the high frequencies. Some people feel a sense of dullness or loss of "airiness" when the high frequency noise (*i.e.*, hiss) is removed. Boosting the very high end (above 10kHz) a tiny bit — 3dB or so — can add some sparkle to the processed sound.

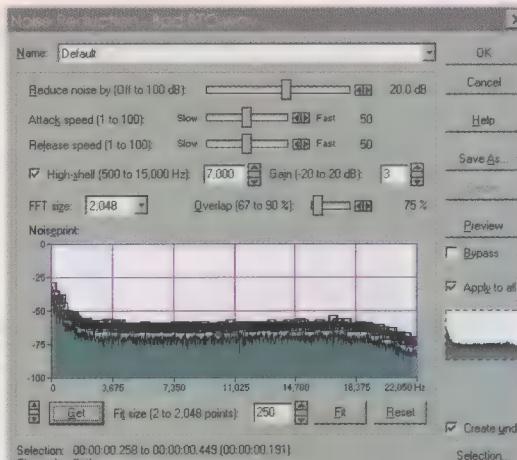
Here's a handy tip that lets you brighten up an existing sound file without boosting the high-frequency noise: First, set the noise reduction amount to 0dB. Now, turn off the High Shelf checkbox and hit Preview. Turn the checkbox back on, move the Gain to about 6dB, and hit Preview again. When you find a setting you like (you may have to play around with the noiseprint envelope points as well), click OK. This technique is different from straight EQ in that the noisy part of the signal is not boosted. It's a great trick for making cymbals stand out of the mix.

### Ground Hum Headaches

We've all heard it. We've all had it. Now, we can get rid of it in the digital realm. The Noise Reduction plug-in is also very effective at removing ground hum from audio. After taking the initial noiseprint, it's possible to zoom into a specific frequency range on the noiseprint (see Figure 3 on page 70). The ability to add and edit envelope points in the noiseprint gives greater control for removing the offensive noise. In this case, the file has a distinctive 60Hz hum. Notice the horizontal spacing of FFT envelope points around the 60Hz "hump." We've added additional points to the contour of the hump for more precise noise reduction around those frequencies. By selecting a range of points (designated red) and dragging them up to a higher value, you can increase the amount of noise reduction at those frequencies. Budda bing, budda boom — 60Hz hum is outta there!

### Click & Pop Removal

Clicks and pops are normally a result of bad splice editing, deteriorated audio



**Fig. 2.** The dark green region in the Noiseprint window represents the noise that Sound Forge has detected in the audio file. (The vertical axis shows level and the horizontal axis shows frequency.) The secondary line just above that region is composed of little squares called "envelope points," which can be thought of as sliders on a graphic equalizer. Dragging them up or down will raise or lower the amount of noise reduction at that frequency.

cables, or damaged vinyl recordings. They can be seen as a sharp spike in the normal curve of a waveform. Sonic Foundry has made it easy to remove these as well.

Choose "Click Removal Settings" from the Tools menu, then select a preset (*e.g.*, Click Removal 1), and push OK. The software automatically scans the entire file for clicks and removes them. Specific sections of a file can be defined and scanned by pressing the Selection button in the settings dialog. This is handy if the same audio file has different types of clicks or pops, requiring different parameter values.

You're given some control in the settings dialog over what distinguishes a click from source material. The Slope Sensitivity parameter determines how sharp an attack the algorithm will look for. When the program encounters a spike, this parameter helps it resolve the question, "Is this a click, or source material?" Higher Proximity values will result in more glitches being found, while a low setting will force the algorithm to analyze the data more closely before deciding that a glitch is present. Since clicks and pops come in a very large variety, it's not yet possible to have one setting that works best all the time. I've found the default values work well, but if you're detecting too many false clicks, or not finding enough, the Proximity control can help out. (Also, low settings take longer to process.)

Say you made a click-removal pass and the program took out most of the clicks, but some lower-level ones still exist. Increase the Proximity sensitivity and select Find mode. This will allow you to

go through each glitch detected and determine whether you want to fix it or move on. For precision editing, the pencil tool lets you smooth the click manually.

What about stereo files that have a click in one channel? You can get more transparent results by using the "Replace Channel" feature, which replaces the click with sound from the other channel. (Normally, the click-removal algorithm either interpolates points around the click or patches over it with "good" data drawn from before the click.) A short crossfade is then applied to prevent further glitching — pretty seamless!

### Vinyl Recording

If I were recording some new material off of vinyl, I'd be sure to start with a clean record and needle. (Thank you, O Master of the Obvious.) The Vinyl Restoration algorithm is a combination click- and broadband-noise-removal algorithm. Should the source audio have both of these types of noise present, the Vinyl Restoration algorithm makes it easy to remove both at once.

Sound Forge's "Reactive Preview" feature will be your best friend and time-saver here. Each time a parameter is changed, the Reactive Preview will loop and generate a new preview with the new parameter settings. As I noted before, there aren't any specific rules to follow in cleaning up these recordings. It will be a matter of trial and error.

Start by pressing Preview. If not enough clicks are being removed, raise the Click Removal Amount setting until they go away. Now, with the Reduce Noise By value set to 8dB and Affect Frequencies Above at 2,000Hz, start raising the Noise Floor until the high-frequency surface noise is noticeably reduced. This is an efficient way to take out the audio junk.

### Other Neat Stuff

Want to add a unique sound to a drum track? Try artifacting it to death. Set the Noise Reduction amount to about 100dB, increase the Attack Speed, and lower the Release time. Some pretty funky results can come about from using these settings.

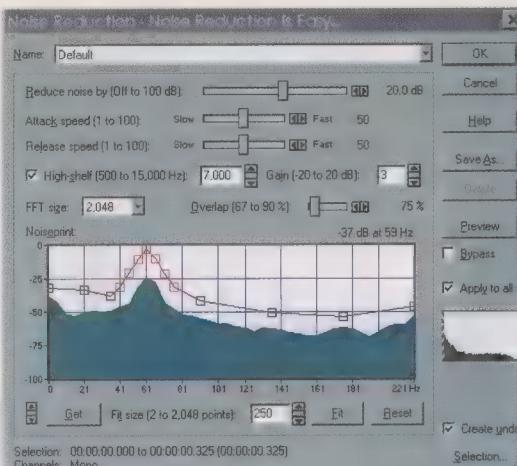
The broadband noise reduction can also be used to make extremely sharp and accurate EQ filters. It's possible to create a "vocal eliminator" effect by notching out prominent vocal frequencies panned in

## Sound Forge TURBO TIPS

the center of a stereo file. Karaoke fans rejoice! By grabbing a frequency's "handle" in the noiseprint and moving it to the top of the graph, you will actually be removing that frequency from the source, because the amount of removal is upward rather than downward. Handles pulled below the noiseprint will not be reduced.

### Limitations

The Noise Reduction plug-in works well to remove constant background noise. In cases where the noise is so prominent that it's loud or louder than the source material, it would be virtually impossible to "pull out" the source without losing audio quality. Some noise sources, such as airplanes flying overhead, babies crying, or a spouse telling you to get off the computer, cannot be removed. Theoretically, you might be able to remove airplane noise by using multiple noiseprints, each in small units of time (via the Selection parameter), because the noise is constantly changing. If you successfully do it, please let me know! You'd be the first.



**Fig. 3.** If you've ever stepped on a guitar cord and recorded that dreaded 60Hz hum, check this out: We've zeroed in on the 60Hz spike in this noiseprint and added extra envelope points to define it precisely. Press OK and the hum will be subtracted from the audio file.

### The Wrap-up

Always be open to experimentation while using noise reduction, because each situation will present a different challenge. Some situations may require additional processing, such as EQ, multi-band compression, etc., after noise reduction to get the best end result. Sonic

Foundry's Sound Forge 4.0 with the Noise Reduction plug-in is a powerful tool for getting the job done. Chances are pretty good that if you are using analog gear somewhere in the recording process, noise is being added to the audio.

Now that my band tape is perfectly audible, it has become a painful reminder of the phrase "Don't quit your day job!" Well, I'll just wait for the Sonic Foundry plug-in that will make me sing better. In the meantime, I'll keep workin' overtime.

Brian Hamilton is the national sales manager for Sonic Foundry. In his free time, or lack thereof, he writes music for jingles and keyboard product demos. You can reach him at [brian@sfoundry.com](mailto:brian@sfoundry.com).

For more information, contact Sonic Foundry, 100 S. Baldwin, Ste. 204, Madison, WI 53703; 800-577-6642 or 608-256-3133; Fax: 608-256-7300; CompuServe: GO SONIC; Web: <http://www.sfoundry.com>.

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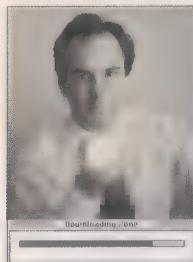
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# Downloading Zone

by John Poultnay

## Son of Something from Nothing

With a few exceptions, I've always felt that New Year's Eve was kind of a letdown. Not only does it present you with a whole new set of psychological barriers with which to torment your already feverish and hallucinating psyche, but it means the holiday season is, well . . . over. Now there's no relief in sight for a couple of months, after having Halloween, Thanksgiving, Hanukkah, Christmas, Kwanzaa, and what-have-you all strung together. And don't start with me about how they combined Lincoln's and Washington's birthdays into one measly day off.

Not that holidays aren't arbitrary anyway; they're just commemorative. Why not make up your own, then? Witness Herb Gardner's 1961 masterpiece *A Thousand Clowns*, wherein unemployed and quirky protagonist Murray Burns informs his young nephew (with whose welfare Murray is charged, lest the New York Child Welfare Department put him in a foster home) that he won't be looking for a job that day. "It's Irving R. Feldman's birthday," he rationalizes. "He is proprietor of perhaps the most distinguished delicatessen in this neighborhood and as such I hold the day of his birth in reverence."

Whatever your favorite holiday is, one factor holds true for most — free stuff. Whether that means a floppy-eared puppy with big paws scampering beneath the tree, or just some free parking, it's something everyone can relate to. Now that the holiday season is over, you can roll your own special days and reap the bounty. From the Internet, of course. To continue last issue's focus of getting something for nothing, I thought I might show you some programs that create music and sounds where there once were none.

**This Could Go Big.** While the results may not be suitable for every festive holiday gathering, Tom Demeyer's BigEye (one of the more esoteric things I've discovered online) will provide you Mac types with some intriguing music. (See Figure 1 on page 72.) The program takes moving visual input and converts it into MIDI

files, taking into account the movement, brightness, size, and coloration of objects in a QuickTime video window. It can use a live video signal from a camera such as the Connectix QuickCam, or can work its magic from a pre-made QuickTime movie.

Some programs you can figure out without the manual. Not so with BigEye, which presents you with a screen displaying the video input. You then select a portion of the screen as a "hot zone," and instruct BigEye to generate MIDI events based on the interaction of moving objects with that zone. This can take three forms: A new object appears in a zone, an existing object moves within a zone, or an existing object disappears from the region. These events might be used, respectively, to generate MIDI Note-Ons, Pitch-Bends, and Note-Offs. But BigEye doesn't stop there. You can also assign MIDI events based on the changing brightness of objects, or on their colors. Up to 16 channels are supported, each running a different video file and generating a separate MIDI data stream. If you're an accomplished programmer, there is a

scripting mode wherein you can control parameters with greater precision.

I had better luck making MIDI with the animated test file supplied with BigEye than with an actual QuickTime movie, probably because the included Read Me document tells exactly how to start working with the example file. But I did get some intriguing on-off kinds of sounds, some with pitch-bends in response to movement. The author suggests that BigEye is useful for real-time performance music, perhaps generated by dancers entering certain areas within a screen. Among the more remote possibilities is "performing bacteria," which would necessitate a video hookup to a microscope. The demo version of BigEye, which is save-disabled, is waiting for you hungrily at <http://www.dds.nl/~steim/prod.html>. (The full-blown BigEye is \$199.) Yes, the Web site is in Dutch, but the product is in English. Go forth and figure.

**Too Much?** A program like BigEye is obviously not for everyone. One that's more universally acceptable is Steven Seeger's DataSnd. This fully functional



little shareware gem converts the data in any file (even non-Mac ones) into sound. Before you get too excited, keep in mind that a lot of files will just produce a bunch of noise. However, some of these noises can be rather interesting. I got cool echoey, *Last In Space*-type beepy sounds from some 3D RayDream Designer texture files, and I got some horrid screeching from a couple of Excel spreadsheets.

You can vary the sample playback rate of files until you find one that sounds acceptable. DataSnd provides preset 5-, 7-, 8-, 11-, 22- and 44kHz rates; you can also set your own, even down to the slow Hz range. Simple, classic, beautiful. Well, not all the sounds you'll get are beautiful, but you'd probably spend a long time devising some of these through conventional means. Call it found art. Get your copy today at [http://liquefy.isca.uiowa.edu/mac/infomac/gst/\\_Sound/](http://liquefy.isca.uiowa.edu/mac/infomac/gst/_Sound/). For you, only \$10.

**Sound Effects for Less.** If you remember those ungainly synthesizers of old with all the sliders, you may take a liking to David Billen's SimSynth. (See Figure 2.) This Windows app gives you a heaping' helpin' of oscillators, filters, and envelope controls in the time-honored spirit of analog. Actually, the interface reminds me of a Roland SH-101, though your mileage may differ. [Ed. Note: See our Jan/Feb '96 issue for background on

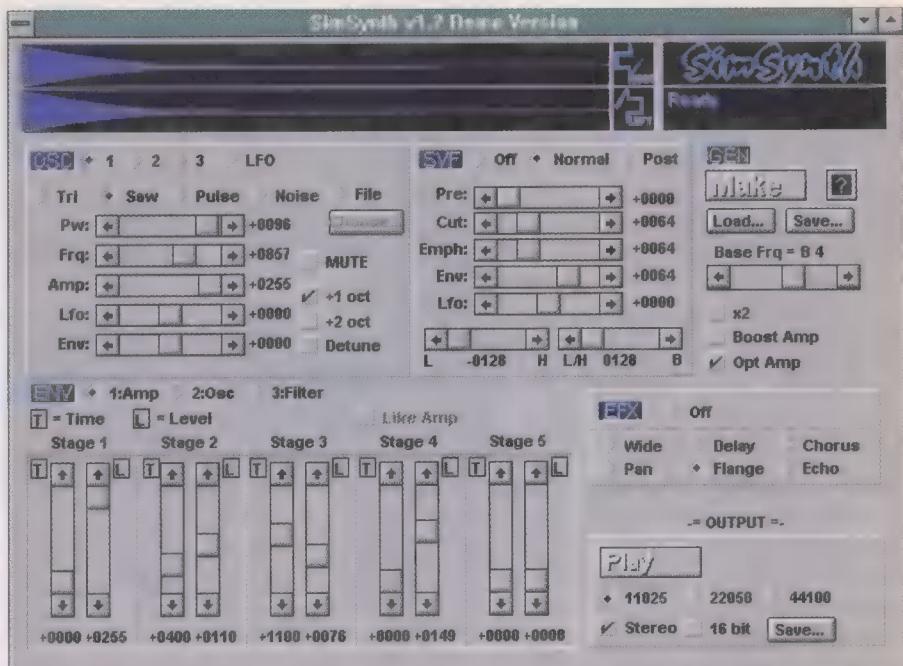


Fig. 2. David Billen's free SimSynth recreates an analog synthesizer in software. Adjust the sliders and press "Make," and the program will generate a .WAV file that you can use in other applications.

#### synthesizer terminology and programming.]

SimSynth should satiate even the most gadget-hungry among us, with up to three standard oscillators, an LFO (low-frequency oscillator), five stages of envelope control (these help contour the shape and level of the sound over time), and a State Variable Filter (SVF). This last feature provides low-, high-, and bandpass filters, along with an emphasis (resonance) control. With each

oscillator, you can adjust the pulse width, frequency, and amplitude. Base frequencies from C0 to C8 are possible, along with the standard complement of delay, chorus, flange, echo and pan effects. Once the settings are set, pressing "Make" will generate a .WAV file of the result, which can be in stereo or mono 8- or 16-bit format, sampled at 11-, 22-, or 44kHz. This operation took a very long time on my old 486/33, but just a couple seconds on my friend's Pentium 166. So unless you're mighty patient, you techno-laggards may want to steer clear of SimSynth until you get a faster machine.

SimSynth does a nice job of making science-fiction sounds, suitable for laboratory scenes in low-budget films where the aliens have landed and are trying to repair the spacecraft before the zealots come to question them. To use it, you'll need a PC with a Sound Blaster or compatible soundcard, and at least a mathcoprocessor-equipped 386. Step right up to <http://www.gibson.com/%7Edbillen> and get a copy while they last.

Between these three programs, you should have enough to keep busy for the next couple of months. I'll be back with more then. You'll see.



Fig. 1. In this screen from Tom Demeyer's BigEye video interpretation software, the square area where the figure's hand is placed is a user-defined "hot zone," which can be assigned to produce various MIDI events when movement is present.

John Poultney (a.k.a. [jpoult7734@aol.com](mailto:jpoult7734@aol.com)) is a writer at MacWEEK magazine in San Francisco. If you don't find him there, or playing bass with his group, the Human Torches (<http://www.actionpacked.com>), you're not looking hard enough. He is kind to most animals.



# Computers in Education

by Ken Johnson

## Building a Music Technology Program

If you want to succeed, someone once said, seek the counsel of one who has succeeded. When I think of people who have succeeded in building valuable music programs through technology, one of the first names I think of is Dennis Mauricio. Dennis developed and runs the Music Technology & Multimedia program at Hilltop High School in Chula Vista, California. He is a staff instructor at the Music Technology and Multimedia summer workshop at the University of Northern Colorado, and has taught workshops at UCLA and San Diego State University. His classroom is an inspirational place to visit — Dennis creates an atmosphere of learning and exploration that his students obviously enjoy and benefit from. For this month's column, I asked Dennis to share his considerable experience in this field.

### How did you first get interested in music technology?

Way before personal computers, I played synthesizers, electric pianos, and Hammond B-3 organs in college bands. I became hooked on the huge palette of sounds that was available.

With my background in composition, I was immediately drawn to MIDI sequencing when personal computers became available. Being able to realize a composition and hear my orchestrations in a single evening really freed up my creativity. Then I began using notation software to produce professional-looking scores. All this opened up a whole new world to me.

**So it was a natural progression for you to bring your interest in music technology into the classroom.**

Yes. In my first job, my assignment was to rebuild an almost nonexistent music program at a high school with practically no feeder program. It was a very challenging

situation. As such, I was interested in any method available to get kids excited about my music program. I started bringing in my keyboards to show the kids. Some kids started hanging around after school and playing with the keyboards. Early on, the principal began taking an interest and helped me get donations of used electronic keyboards and some seed money from the district. Within two years, we had a full-time music program filling up five periods a day.

### How does music technology help students learn more?

It helps kids learn more effectively. The traditional music education approach is to delay composition and improvisation until the student has learned the theory and gained the technical proficiency with an instrument that's required. With music technology, kids can get to the creative process very early on in their musical experience. As their creative juices start to flow, we as teachers can begin building in the traditional harmony, theory, and technical lessons that they'll want to learn in order to reach the next step in their musical growth.

Working with a multitimbral synthesizer and sequencing software, a student gets immediate feedback on his or her musical ideas. They don't have to wait a week to listen to the school orchestra play it; they hear it right now. Since they can make

immediate improvements and corrections, the learning process moves along at an accelerated rate.

**What's important for teachers to keep in mind as they make the transition from using technology personally to integrating technology into their teaching?**

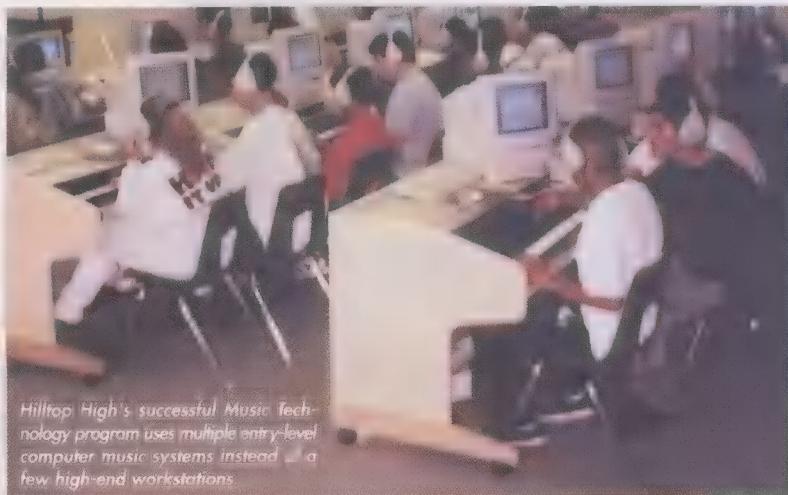
At the most basic level, integrating technology into a music program begins to change a teacher's role in the classroom. Instead of being in the traditional role of the person with all of the answers, we move to the role of facilitator. You must keep in mind that the kids get hold of this equipment and find valid, new ways of using it that oftentimes you'd never have thought of. My first impulse as a teacher when this happens is to say, "No, we're not going to do it that way; this is the way it should be done." However, the kids learn in very creative ways when you allow them to pursue their own ideas, and you must be open to the possibility that they may find a better way of getting something done.

Along the same lines, you must realize that you won't have all the answers. Things change so quickly — new software versions, new keyboards, and completely new technologies will appear in your classroom at such an alarming rate that it'll be impossible for a single person to keep up. So sometimes my students are more knowledgeable

about the operation of a certain software program or piece of equipment than I am.

Let the kids teach you. I often use the "let's make a deal" approach when we need to learn a new piece of equipment or software program: I'll give a kid or a group of kids time to work on a new piece of equipment or software as long as they teach me what they've learned.

**Your kids have written, arranged, performed, and engineered**



Hilltop High's successful Music Technology program uses multiple entry-level computer music systems instead of a few high-end workstations.

### **their own CD. Why is this a valuable experience for them?**

Well, we do everything in-house, right up to taking it to a mastering facility for digital mastering and mass duplication. So the students are taking on a complex, large-scale project and seeing it through to completion. It's a very real-life situation that provides lessons at many levels.

First of all, the level of musical critiquing that takes place goes far beyond what happens in a performing situation. In preparing for a live performance, some details may escape the close attention of students — they just roll through it despite your attempts to focus their attention. But on a recording, those details are there forever. Students will listen to their performances and refine them to a much higher level of musicianship when they are committing something to a recording.

Students also learn to work together as a group. They learn principles of organization and productivity. They learn to evaluate their strengths and weaknesses. I try to structure the production of the CD as faithfully as possible to the realities of producing a project like this in a real studio environment. The kids are accountable for their time. They must have their recording sessions well planned.

Finally, since we finance the CD ourselves, they pick up the whole music business side of the experience. There are mechanical fees and contacts with ASCAP and BMI. We do estimates for profit and loss, knowing where our break-even point is going to be and where our profit margin is in terms of sales. This is not homework on a piece of paper; it's the real thing, and students invest an awful lot into it.

A big movement in education is performance and portfolio assessment, moving away from just a grade on a paper to a real-life experience. You can't get much more authentic and real-life than producing your own CD! It also gives kids a product they can use when auditioning for a college music program.

The reality is that most of us are going to be in fund-raising mode at one time or another. Philosophically, I prefer doing educationally meaningful fund-raising experiences like producing and selling a CD to doing a car wash or selling candy bars.

### **Many music teachers don't have elaborate computer and keyboard labs. How can they best utilize a limited amount of equipment in the classroom?**

When I started out, I went for the biggest bang for the buck in terms of giving as many kids exposure to a given technology as possible. For \$3,500 you can put together

a real nice computer music workstation, but only a few kids at a time can work on it. With that same \$3,500 you can purchase 12 or more entry-level keyboards with full-size keys that a couple of kids can share at a time. Now 24 kids are involved with music technology instead of just a few.

I've always used a multi-station approach to my classroom, which helps to address this problem as well. When I first started out, I set up a station with keyboards, another with a few computers, another with other musical instruments and perhaps a 4-track recorder, and still another where they document their progress with some paperwork. Then I design lesson plans that rotate the students through these stations in a meaningful way.

There's a down side to getting a lot of money all at once and running out to buy a big lab — things become obsolete quickly. If that's the only money you're going to get for a long time, you could find yourself with a ton of outdated equipment in just a few years. Don't get me wrong: It's great to get a lot of money, but always be looking for the long-term, consistent funding sources in addition to the windfalls.

### **How have you funded the expansion of your program?**

Our latest expansion was funded by a grant from the Carl Perkins Applied Technology and Vocational Act. Traditionally, a music program wouldn't qualify for a grant like this, but when we looked at our program creatively, we realized we satisfied the conditions perfectly — we were applying technology in the field of music with a strong emphasis on vocation-oriented outcomes.

We're not accustomed to framing our music programs with the buzzwords that attract funding, like "preparing students for the 21st Century" and "school-to-career programs," for instance. But by locking onto the concepts that are attracting funds in their district, music teachers can begin getting their fair share of the pie.

I felt it was important to give our program exposure and to enlist the support of our entire community. So early in our development, we created a music technology ensemble that played frequently in the community. When you mention music technology in education, most often people think of the lab approach, which is very valid and important. However, the benefits of the lab approach tend to be confined to the classroom, and people at the administrative level and in the community don't see all the good things that go on. A performance group that utilizes technology is much more visible. It's also exciting, unique, and capable of drawing a lot of attention to your program.

In my case, I was very fortunate to have a superintendent who saw the technology performance group and captured the vision of where I wanted to go. By raising the awareness of my music program, we eventually also enlisted the support of the parents, the administration, and the entire student body.

If you're having limited success getting the support of your administration, focus on your community. Once the administration sees that the community is catching on to your program and saying great things about it, they'll be motivated to jump on the bandwagon — everybody loves good press!

### **Is there a point where utilizing technology in music instruction can become counterproductive to achieving musical objectives?**

Yes, in a couple of ways. As you incorporate more types of technology into your room, the possibility for technical problems to arise seems to increase exponentially. A mouse breaks, MIDI isn't working on a system, there's a computer glitch over here, etc. Since most schools don't provide lab technicians to solve problems on the spot, the teacher has to assume this additional role. Being the teacher, the facilitator, the musician, the software specialist, the systems engineer, and the technical troubleshooter all at any given moment can be overwhelming.

It's very important to pace yourself. Grow into new technologies at a manageable rate. I try to train my more advanced students to be problem solvers and lab assistants to relieve me of this burden.

Also, if we're not careful, the technology can become an end rather than a means to an end. If the goal of a program is to create music and foster the development of musical skills, students must always be directed toward those goals. A mastery of these new tools and technologies is important only to the extent that your musical goals are being reached. Even in a class on audio engineering, where the tools and the techniques are the subject matter, the end result is still recording or reinforcing good music. It's important to not get too distracted by the equipment or the software.

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# MOD Philes

by Eric Bell

## Flitting, Teasing, Ghostly Kisses

**H**appy MOD Year! Just to prove that both virtual music and the virtual corporation are here for real, I'm writing this month from Vancouver, Canada, 2,500 miles from my (physical reality) desk. I brought a full-size PC with me on the road so I could plug in various soundcards. (More on that later.)

Once I got my Net connection sorted out, I was right back on track and tracking, listening to the MOD files you sent in. (See the "MOD Philes Online" sidebar on page 76.) The point is, you can be anywhere; if you're good, we'll hear you. And if you want to listen, you can listen from anywhere. It all comes together in the music.

What a treat you trackers have given me! Loads of great MODs to listen to in all kinds of formats, from all over the world. This month, I'm kicking off with a short but sweet nouveau-classical piece by **Dead**, called "Little Concert Opus 1." (Dead, or Mr. Dead as I call him, is also known as Fabio Prestes de Oliveira of Brazil.)

This piece is a FastTracker II .XM file that is a very reasonable size — 350Kb. Sorry, but I have a problem with some of the bloated tracks that have been uploaded lately. Sampling is an art. Most of the time, a huge sample set is a tip-off that there isn't much creativity in the use of the samples. Try to load a little less on your plate, and then make more use of it. Just because it's an audio buffet doesn't mean you have to have *everything*. On a more practical note, our server is getting jammed, so please don't upload anything larger than 1Mb. PKZipped. Don't agree? Log on and have your say in the MOD Philes Phorum.

Dead has concentrated on making his own string samples. That's all there are in this tune, and he says they're 99% his. Now this is what I like to see — a tracker who makes his own set of samples, and uses them in a focused way. (We'll see if they really are "his" later.)

"Little Concert" has a pretty set of chord changes, outlined by an arpeggiating string line. At appropriate moments, it is filled in with sustaining chords. The timbres of the different stringed instruments — cellos, violins, basses — are clearly audible. A beautiful and haunting melody line is accented by a wonderful counterpoint, which crosses over and under the main melody, flitting, teasing, and giving ghostly kisses.

Notice how the lead changes hands from one instrument to another during the piece. Interest is maintained, even though there is a limited set of sounds to work with — always a challenge when writing a good MOD track. The piece is strongly composed, in the melodic and harmonic sense, and it has great cohesiveness. Each section follows the previous one in a logical but not predictable way. Like an unexpected encounter, "Little Concert" ends all too soon, but perhaps just at the right moment.

"When I started to compose classical music using Scream Tracker," Dead says,

"I normally used one sample per instrument. I got them from my keyboard, my guitar, or ripped [extracted] them from other songs. Everyone thought the instruments were very artificial.

"The solution was FastTracker, which allows you to use different samples for different notes of the same instrument [i.e., allows multisampling]. My first victory was to find the [ripped-off sound source] that had scales of one or two octaves for each instrument. I copied the original sample file to my hard drive, converted it to .WAV in Cool Edit, and used WAV\_2\_XI to convert the .WAV file to an .XI file (FastTracker instrument). Finally, I edited the sounds in FastTracker."

(MOD Philes Legal Counsel: We do not condone the "ripping" of copyrighted sounds. Thank you.)

Even though he used some liberty in making his samples, Dead gets cool free stuff for this wonderful piece.

"Flash Counter" by **Kleitus** (a.k.a. Seth Katzman of the group Inferno) is labeled as demo music, and one can easily imagine



the sort of eye-popping graphics this tune might inspire. (In the MOD world, "demos" are programs that combine cutting-edge graphics with MOD soundtracks.) "Flash Counter" has an up-tempo syncopated chord comp, which, together with a nailed-down drum groove, motorizes this song through the first couple of verses. (Sounds like a wine tasting: Hmm, it has a sparkling acidity with a floral yet bittersweet afterburn.)

One of the things I like about "Flash Counter" is the cool resonant sample that Kleitus pans back and forth across the

soundstage. It adds an interesting texture to the piece. The song builds through the first third into a synth solo based on an interesting sound that cuts through the mix well. The solo lasts for a single verse, and then there is an unexpected piano interlude at a slower tempo. This is a nice complement to the rest of the piece. When the fast syncopated chords make their reprise, there is a sensation of shifting into overdrive, putting the pedal down, and taking off into oblivion.

The excellent use of tracker commands — the manipulation of panning in

the first third, and the use of volume and portamento changes during the solo — gives life and expression, which improve the song greatly. Finally, at the end of the bridge, the tempo is brought up ever so slightly into the rock reprise. Very simple, very effective.

Kleitus explains, "'Flash Counter' was the first song I ever finished. I got some serious help with how certain effects work, and also tips on how to use various tracking techniques from a friend, Kal Zakath, a.k.a. John Townsend."

In the world of MODs, there are various effects you can add to the bare samples, such as volume slides (changes), portamento (bending from one pitch to another without stopping the sound), etc. They are added to a song by typing in numeric values into the *tracker*, or composing program. "Set Volume is the single most important tracker effect," Kleitus asserts. "I tried to fiddle with this as much as possible. I tweaked various volume settings on notes, the piano part, and synth backgrounds to get a well-mixed song."

"The Portamento command was pretty straightforward. The main thing I used it for was to make my melody instrument sound smooth. If I laid out notes, and the melody sounded too abrupt, I would tweak it with a nice 'porta.' I also used tricks like inserting slow portas in the transition between the intro and the main melody part."

"I used vibrato to get a sweeter sound on the leads. The only other notable effect I used was by accident. I was fiddling with a background synth noise to give the piece a fuller sound. I accidentally laid out porta and volume slides in every other row, which made this awesome sound. That's probably the pattern I'm most proud of tracking in that particular tune."

Kleitus gets a Christmas sock full of free music goodies, and a lump of silicon instead of coal. Check back next issue, when we review the mammoth 18,000-MODs-melting-my-brain, four-disk, multiplatform *MOD Anthology* set [deep breath]. Wow! Can't wait!

## Mod Philes Online

You can get to us through any of these Web addresses:

<http://www.howlingdog.com>

<http://www.midifarm.com>

<http://www.music-and-computers.com>

There you'll find the tunes discussed in this column, tools to play and compose MODs, feedback from other readers, and lots more. To submit your original MOD tunes, just log on and follow the instructions.

If your MOD composition is selected for

coverage in this column, you'll receive one of a number of fine prizes, such as Midiman's MultiMixer 6 mixer (visit them at <http://www.midifarm.com/midiman>), Sonic Foundry's Sound Forge XP digital audio editing tools for Windows (see <http://www.sfoundry.com>), Synergy's ViperMAX soundcard (see <http://www.pctoybox.com>), or Schatztruh's MODs Anthology CD-ROM of 18,000 MODs (see <http://www.schatztruh.de> or <http://www.ninemoons.com>).



## Nebulosity Contest

Nebulosity is a tracked-music competition put on by the group Nebula. This competition will have lots of different categories for various musical styles. Amongst the prizes are a new computer system, so you'd better enter! Details are available on the MOD Philes Web site or at <http://www.center-nebula.com/nebulosity>. The deadline for entries is January 31, 1997.



## A Better GUS than UltraSound?

The MOD scene owes a debt to the GF1 chip used on Gravis's UltraSound (GUS) PC soundcards. These soundcards are excellent for MOD playback because they can mix up to 32 digital audio channels in the hardware (and each note you hear in a MOD needs a digital channel). The weak side of the GUS has always been its finicky software-based Sound Blaster "compatibility."

A company called Synergy has the answer to your GUSly prayers — the new ViperMAX card, which has a genuine GF1 on board, 1 meg of RAM, and hardware Sound Blaster compatibility, thanks to its ESS chipset. You want GUS for MOD tracking and *DOOM*? You've got it. You want hassle-free SB sound for games? Got it! What's more, we've got a ViperMAX for you if we write about your MODs.

Just before deadline I confirmed that Gravis has a new SB-compatible GUS, too. It's called the UltraSound Extreme. It will be sold through the retail channel in Europe and direct to end users in North America from Gravis (800-663-8558).



Eric Bell is president of Howling Dog Systems, makers of the Power Chords line of music composition software and the Power Patch samples for soundcards. You can reach him at [howling.dog@sympatico.ca](mailto:howling.dog@sympatico.ca).



# Ride the Wired Surf

with the Fat Man

## Designing the Musical Computer

Last autumn, on a bluff overlooking the Guadalupe River in southern Texas, 35 parts of a huge 35-piece brain that had been split for many years were put back together. The event was Project Bar-B-Q, Team Fat's intense Texas-style think tank for the computer audio industry. The challenge was answering the question, "What do you want to see in hardware and software for music on computers in the next five years?"

Thirty-five brilliant people who had been frustrated for years that they didn't have the mental capability to design the ideal musical computer by themselves were somehow enabled to do a task that they'd always wanted to do. I feel privileged to have been around that kind of brain power. There were luminaries from Microsoft and Apple, Intel and VLSI, Yamaha and Roland, Sonic Foundry, LucasArts, and Prodigy. There were producers, sound designers, composers, hardware and software engineers, and more.

**Fill 'er Up.** Speakers came in and loaded the group up with huge blocks of information: the psychological power of multichannel surround sound, the 100% Digital Audio PC, the \$5 connector capable of 400Mb/sec data transfer, Grammy Awards for interactive music. . . . Their brains would be filled by one speaker and they'd go into a Q&A, then just at the point where it was getting really exciting — boom! The next speaker would come out. So their heads were filling up with both ideas and a dire urge to investigate and contribute.

Then they were introduced to the groups they would be working with, and just as they got to know them, we broke and went to the cowboy theater to watch the dancing longhorn. Very few went to sleep before 2:00 A.M., standing up long and hard for what they believed in, all while jamming out surf tunes.

**Listen.** It became clear that it was very important to raise the public

consciousness about how great a computer experience can be with excellent sound. A chicken-and-egg hardware/software question arose: We need great hardware, but what kind of hardware do we build to allow software to prove the point? And the software guys were saying, "What's the point of writing the software if the hardware doesn't exist?" With that up in the air, we continued on our track of answering The Question while two rogue groups spun off.

That was one of the most dramatic moments of the conference: Steve Purves of Aura Systems stood up and said, "You know, we've got the hardware guys here; we've got the software guys here; we've got the artists — why don't we just build this thing?"

It was like being in a Mickey Rooney film, when they stand up and say, "Hey! There's an old barn out back. Let's clean it up and put on a show!" But it was real. And it involved significant players in the field.

So that was the "platform" rogue group. The other group that spun off was the interactive composition group, those incredibly heavy guys, Monty Schmidt of Sonic

Foundry, Mark Miller, who runs the Interactive Audio Special Interest Group, Michael Land of LucasArts, whose games lead the field in interactive digital audio, and Todor Fay of Microsoft, who's leading the way with interactive MIDI. There they were, sitting around the hot tub, going for it.

Then the presentations happened, and essentially, the conference ended. A lot of very exciting information was put out, and Team Fat said everybody could go home, but nearly the entire group volunteered to go into overtime. What happened next was dynamic.

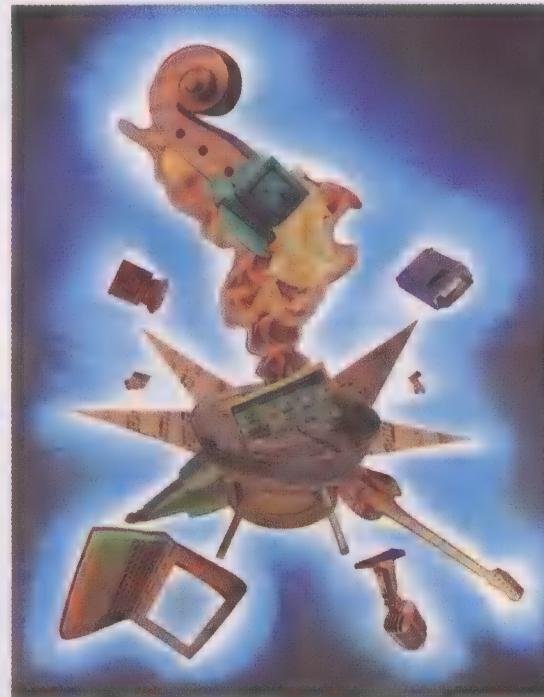
**Solutions.** Suddenly, the interactive composition group stands up and says, "Here's what we think an interactive composition language should have." This was something Mark had been working on for several years. But now, every force around him, everything he had thought about and been through in the last two days, was aimed at supporting his ability to synthesize information. Ironically, when Mark stood up and announced their conclusions, Jim Reekes from Apple interjected, "Excuse me if I'm out of line here, but you're describing QuickTime."

"Yeah, but can it work on the PlayStation? Can it work on the—?" And Jim said, "Yes, it can."

"Why didn't we know about that?"

I have the answer: If you think you have an enemy, you'd do well to track him down and buy him a beer. It might just turn out that you've got a friend.

**Hands in the Air.** The platform group had asked that we focus attention on killer software apps, something to demonstrate the emotional power of good musical hardware and software. Under the pressure of the group that wanted to show the world how cool music on computers could be, the hardware and software guys started to click. We'd ask the software guys, "Who here is thinking of a killer app?" And they would raise their hands. Then we'd say, "Who wouldn't be able to create their killer app on a computer with these features?" and the hands would go down, until there were no hands



## Ride the Wired Surf

in the air. We had created a spec list that no one in that room wouldn't be able to create their killer app on.

Like Willy Wonka's machine that was supposed to turn out the Everlasting Gobstopper, this machine was as big a room, and it chunked and it churned and it banged for 15 minutes and out popped a little piece of candy. We ended up with ten features on a big piece of paper that says what we want to see in hardware. Not in the next five years — now. And the interactive composing group, together with the Apple folks, defined a huge chunk of what we want to see in software. That, combined with all the work of the working groups, created a beautiful moment.

**Without a Guitar.** These people have been in rooms together before. It's very different. There are some tasks you can accomplish extremely well under fluorescent lights, wearing a suit and tie, with a name tag, under heavy pressure, without a drink, and without a guitar. But other tasks are just not meant to be approached under those circumstances. Without a guitar, how can you talk about where music will be? Without hearing in your heart what music is, you're likely to forget. You're likely to think for a moment that

music is a certain number of bits, a certain configuration of hardware through which the hired composer has been paid to elicit certain tones. That's not music.

There were many opportunities for conflict. They were handled with amazing chivalry and good manners. The guys from Roland and Yamaha could have sat anywhere during the awards ceremony, but they were next to each other and they were laughing and roaring and having a great of time. There was at least one person who showed up with the idea that Company X was the bad guys, and after the very first evening knew that it wasn't Company X. That thought was replaced by the thought, "Boris from Company X has a job to do, and he seems to be very capable of doing it well." It was defused.

People were courteous, but they weren't timid. I believe that everything that needed to be said got said. When Michael challenged Todor, putting the benefits of a digital audio approach to interactive music up against the benefits of MIDI, I thought, "Oh boy, this is where the whole thing splits." But there was so much mutual respect that it didn't split in a way that would be disappointing. It was more like splitting the big part of a mitten into separate fingers.

I think it was a deeply personal experience for a lot of people. Something very cool went on, and I feel very lucky to have been a part of it. I'll even go so far as to say I feel downright humbled. And that's saying something!

**Onward.** I think Bar-B-Q can help raise the public's awareness of how high-quality music affects the computer experience. Bar-B-Q can take its place in the ranks of the forces that are saying, "Here, public, music rocks the box. Music is something that makes your heart thump, your palms sweat, makes you remember good times at the beach, and here's that experience presented by one very sharp 35-piece brain . . . wearing cowboy hats and Prodigy bolo ties." By next issue, we hope to have the specs for the ideal music computer nailed down. See you then. 

*The Fat Man, George Alistair Sanger, is internationally known as the biggest name in music for interactive entertainment. Together with Team Fat, his gang of cowboy composers, he has contributed the musical scores for over 100 software products. For more Fat thoughts and music, visit <http://fatman.outer.net>.*

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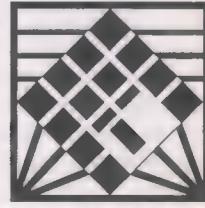


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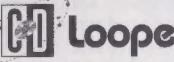
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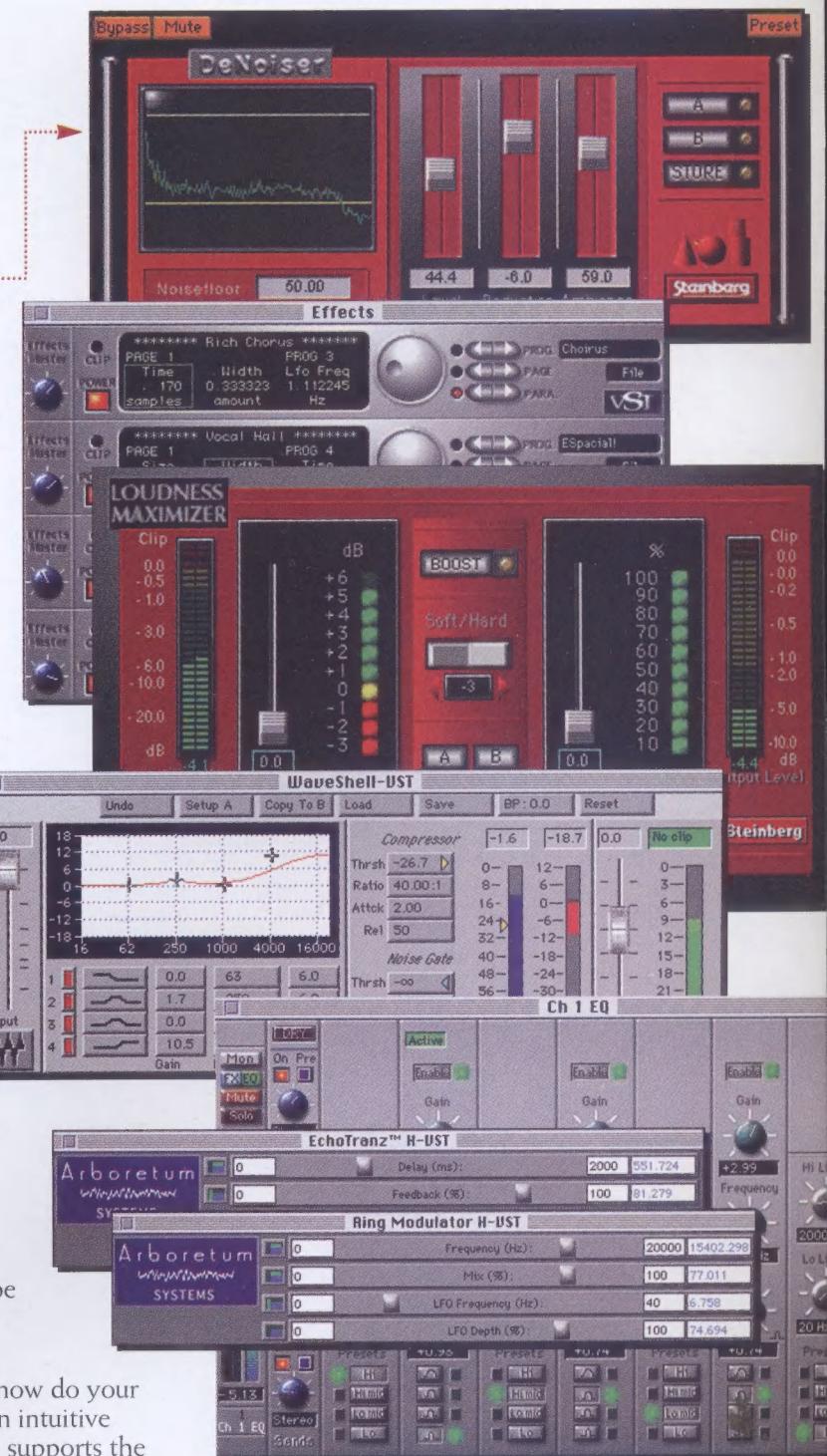
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